file: RCY

STATE OF MISSOURI
Mel Carnahan, Governor • David A. Shorr, Director
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

June 21, 1995

Ms. Carrie Ruggles
Camden County Library District
P.O. Box 1320
Camdenton, MO 65020

RE: Modification Request for Modine Heat Transfer's Closure Plan
Located at Sunset Drive, Camdenton, Missouri
EPA ID Number: MOD062439351

Dear Ms. Ruggles:

Enclosed is a copy of a closure plan modification request and legal notice for the above-referenced facility. This facility is requesting to modify its approved closure plan.

The Missouri Department of Natural Resources is requesting that this plan be made available for public viewing at your library. Public notice is being given via a legal notice published in the Lake Sun-Leader stating that this document is available for public viewing at the Camden County Library District. After August 10, 1995, you may discard the plan unless further notice is given.

Thank you for your cooperation in this matter. If you have any questions, please contact me at (314) 751-3176.

Sincerely,

HAZARDOUS WASTE PROGRAM

Darleen Westcott

Darleen Westcott
Environmental Engineer
Permits Section

DW:sw

c: Bob Stewart, P.E., U.S. EPA Region VII
Mr. Thomas Sanicola, Modine Manufacturing Company
Jefferson City Regional Office

DAMES & MOORE
2135 E. SUNSHINE, SUITE 105, SPRINGFIELD, MISSOURI 65804
(417) 881-3927 FAX: (417) 881-6361

June 1, 1995

Ms. Darleen Westcott
Environmental Engineer
Hazardous Waste Program
Missouri Department of Natural Resources
205 Jefferson
Jefferson City, Missouri 65102

RE: WORK PLAN MODIFICATION FOR AN INVESTIGATION TO ACHIEVE FINAL CLOSURE OF THE INTERIM TSD FACILITY LOCATED AT THE MODINE HEAT TRANSFER, INC. SITE CAMDENTON, MISSOURI

Dear Ms. Westcott:

On behalf of Modine Manufacturing Company (Modine) Dames & Moore is submitting three copies of the above referenced Work Plan. The Work Plan has been revised to incorporate the Missouri Department of Natural Resources (MoDNR) comments and changes as relayed to us in the meeting of April 24, 1995. Please distribute a copy to Mr. Richard Nussbaum and Mr. Bruce Stewart of your office.

Following MoDNR approval of the Work Plan, we will begin preparation for implementation of the field work. If you have any questions, please contact me at (417) 881-3927 or Mr. Thomas Sanicola with Modine at (414) 636-1649.

Very truly yours,

DAMES & MOORE, INC.

Daniel J. Price
Senior Geologist

Enclosures

c: Thomas Sanicola - Modine

WORK PLAN MODIFICATION FOR AN INVESTIGATION TO ACHIEVE FINAL CLOSURE OF THE INTERIM TSD FACILITY LOCATED AT THE MODINE HEAT TRANSFER, INC. SITE CAMDENTON, MISSOURI

Prepared For
MODINE MANUFACTURING COMPANY

DAMES & MOORE

Revision 1 - June 1, 1995

Dames & Moore, Inc.
Springfield, Missouri

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APPENDICES

1.0 INTRODUCTION

Modine Manufacturing Company (Modine) is submitting this work plan in response to a request from the Missouri Department of Natural Resources (MoDNR). This work plan defines the work to be performed to facilitate final closure of the interim treatment, storage, or disposal (TSD) facility at the Modine Heat Transfer, Inc. site in Camdenton, Missouri.

In a meeting between MoDNR and Modine on February 9, 1995, MoDNR requested that Modine submit a work plan modification to the previously submitted closure plan for review and approval prior to the implementation of the work to achieve final closure. The negotiated tasks to be completed prior to MoDNR granting closure of the interim TSD facility at the Camdenton site include:

- Further investigation of the apparent impact to groundwater identified from MoDNR sampling event of December 1994; and,

- Investigation and/or remediation of the lead impact to soil identified at boring B-11.

A first draft of this work plan was submitted to MoDNR on April 20, 1995, for review and discussion purposes. During a meeting with MoDNR held on April 24, 1995, at the Modine site in Camdenton, it was made clear that addressing only the above referenced points would be insufficient to satisfy MoDNR and achieve final closure. The purpose of this work plan is to adequately address the work to be conducted to satisfy all MoDNR requirements and achieve final closure of the Resource Conservation and Recovery Act (RCRA) regulated TSD facility. The work to be performed in achieving this goal, and addressed in this revised work plan, includes:

- Installation of one on-site groundwater monitoring well;

- Continued quarterly sampling of the two on-site monitoring wells and the newly installed monitoring well;

- Removal of the impacted soil in an area of elevated lead concentrations;

- Installation of additional soil borings to assess the rate and extent of the volatile organic compounds (VOCs) present in soil at the site along the west side of the building; and,

- Preparation of a final closure report.

2.0 BACKGROUND

2.1 Site Location and Operational History

The Modine Heat Transfer, Inc. site is located on Sunset Drive in Camdenton, Missouri. The site occupies approximately 100 acres in Section 26, Township 38 North, Range 17 West in Camden County. The one manufacturing plant at the site occupies approximately 83,000 square feet and has undergone four construction additions through its history (1971, 1973, 1979, and 1983).

Operations began at the site in 1967 under the ownership of Dawson Metal Products. Sundstrand Tubular Products (Sundstrand) purchased the site in 1974 and operated it until 1990. Modine Heat Transfer, Inc., a wholly owned subsidiary of Modine Manufacturing Company, purchased the site in October 1990. The site has always been utilized in the manufacture of aluminum and copper coils and feeder parts used in the manufacture of heat transfer products.

2.2 Regulatory History

A RCRA Part A Permit application to operate a storage facility was submitted by the former owners of the facility (Sundstrand) to the U.S. Environmental Protection Agency (USEPA) in November 1980. Revisions to the Part A permit were filed in 1983 and 1990. A RCRA Part B Permit application has never been filed; therefore, the facility has been operating as a TSD facility under interim status.

Prior to purchase of the site by Modine, Sundstrand submitted a Closure Plan in September 1990 to terminate its interim status and hold generator status only. The Closure Plan

addressed three former storage areas, all located on the west side of the building. The three areas covered by the Closure Plan include:

- Area 1: 1980 - 1983 Drum Storage Area
- Area 2: 1983 - 1985 Tank and Drum Storage Area
- Area 3: 1985 - 1990 Tank and Drum Storage Area

The Closure Plan was revised by Modine in February 1992 and approved with modifications by MoDNR in November 1992. The content of these modifications were negotiated and an agreement, including the following sampling tasks, was reached between Modine and MoDNR:

- Collection of additional soil samples near the former outside drum storage area (Area 1); and,

- Collection of wet mop/wipe samples from the inside drum storage area (Area 2 and 3).

This work was performed in July 1993. However, due to the detection of some constituents in the soil, clean closure was not obtained and final closure of the TSD facility was not granted by MoDNR in March 1994. Rather than do excessive excavation and investigation Modine requested to demonstrate a risk-based closure. An environmental risk assessment (risk assessment analysis of the soil) was conducted in August of 1994 to assess the potential impacts on human health from the soil. Following completion of the risk assessment, Modine was notified by MoDNR that the assessment did not fulfill the closure requirements with regard to the groundwater issue.

2.3 Summary of Results from Previous Site Investigations

In response to an alleged 4,500 gallon release of spent solvent filed with MoDNR, Modine was requested to conduct an Environmental Site Assessment (ESA) at the facility. The ESA was conducted in November 1991 and included the installation of five soil borings in the area of the suspected release and four soil borings on the west side of the building near a reported former drum storage area. The plant was expanded between the time of the reported spill and the investigation. At the time of the investigation the area of the suspected release

housed the monorail degreaser and associate containment pit. The soil results indicated generally low (less than 1 part per million (ppm)) volatile organic compound (VOC) concentrations in the near surface (less than 10 feet) on the west side of the building. The results from inside the building indicated VOC concentrations below 1 ppm with two exceptions: 1,1,1-Trichloroethane (TCA) was encountered at a concentration of 200 ppm, and Trichloroethene (TCE) at a concentration of 3 ppm. A removable threaded plug and countersink was installed at the boring location exhibiting the 200 ppm TCA concentration to allow for future sampling access of accumulated fluid.

Due to the constituents identified during the ESA, MoDNR conducted a site inspection in July 1992 that included installation of the two on-site monitoring wells. The investigation showed some minor TCE concentrations (less than 1 ppm) in the grab soil samples from above 20 feet in the boring for monitoring well MW-2. The groundwater samples collected from both wells did not exhibit any VOC concentrations above detectable levels. Based upon the results of this investigation the Superfund Section of the MoDNR Hazardous Waste Program concluded that no further action was necessary.

Approval of the closure plan with modifications was granted by MoDNR in November 1992. Subsequent negotiations regarding the modifications resulted in an agreement being reached in March 1993. The agreed upon modifications included additional subsurface soil sampling in Area 1 and Area 2 to obtain final closure of the TSD. The results of an investigation conducted in July 1993, indicated VOC concentrations of less than 0.1 ppm in all soil samples collected and one elevated lead concentration of 1,400 ppm in boring B-11 adjacent to Area 2. A background boring was also installed as part of this investigation and a soil sample collected from this boring exhibited a lead concentration of 240 ppm.

A spill of TCA occurred in early 1992 from a monorail degreaser in the plant (same area investigated in ESA 11/91). It was estimated that 1,675 gallons had spilled into the machine pit/containment sump. Plant personnel recovered 1,469 gallons using a vacuum system. The estimated loss of approximately 206 gallons was primarily attributable to volatilization. A groundwater sample was collected in October 1993 from the boring with the removable plug. The sample exhibited a TCA concentration of 0.044 parts per billion (ppb).

An Environmental Risk Assessment (discussed briefly in Section 2.2) was conducted in August 1994. The results indicated the following: no health risk was posed by the minimal amounts of VOCs in the soil, and that lead in soil was not considered a significant risk based constituent. The Assessment concluded that further soil remediation was not necessary based upon risk.

The MoDNR conducted a RCRA sampling investigation on December 7, 1994. The purpose of the investigation was to sample the two on-site monitoring wells. Analytical results were as follows: the groundwater sample from MW-1 exhibited a TCE concentration of 6.9 ppb, and the groundwater sample from MW-2 exhibited a TCE concentration of below the detection limit of 5 ppb. The duplicate sample from MW-2 exhibited a TCE concentration of 5.1 ppb. No VOCs were detected in the field blank or bailer blank. Modine provided bottles for collection and analysis of a split sample. Results obtained on the split samples were 6.1 ppb TCE in the groundwater sample from MW-1 and below detectable levels (less than 5 ppb) in the groundwater sample from MW-2.

The most recent round of sampling of the two on-site monitoring wells was conducted on February 23, 1995, by Modine. The results from this sampling event indicated TCE concentrations below the Drinking Water Maximum Contaminant Level (MCL) of 5 ppb in the groundwater sample from MW-1 and both the original and duplicate groundwater sample from MW-2. No VOCs were detected in the trip blank or equipment blank.

3.0 SITE SETTING

3.1 Geology

The site is located on an east to west trending small ridge top on the Salem Plateau, a subprovince of the Ozark Province. Ground surface at the site is mildly sloping to steeply sloping on the southern portion of the site. Topographic relief across the majority of the site is approximately 20 feet. Elevation at the plant is approximately 960 feet above mean sea level (msl).

3.1.1 Soil

The predominant soil at the site is classified as the Lebanon silt loam by the U.S. Soil Conservation Service (SCS). This soil is a gently sloping (2 to 5 percent slopes), moderately well drained soil that typically forms on ridgetops. The surface layer is typically dark brown silt loam approximately 6 inches thick. The 17 inch thick subsoil, present above a fragipan, is composed of brown silty clay loam to gray-brown mottled silty clay. The fragipan is about 14 inches thick and consists of a very dense brown-gray mottled extremely cherty silt loam. Beneath the fragipan, and extending to bedrock, is a red-brown mottled very cherty to cherty clay. Permeability in the Lebanon soil is characterized as slow (0.06 to 0.2 inches per hour (in/hr)) to very slow (less than 0.06 in/hr).

Other soil types present at the site, primarily on the south and far west sides, include the Doniphan very cherty silt loam and the Niangua-Bradley very cherty silt loam. Permeability in these soil types are moderate (0.6 to 2.0 in/hr) to moderately slow (0.2 to 0.6 in/hr), with the exception of the top one foot of the Doniphan where permeability is moderately rapid (2.0 to 6.0 in/hr).

Soil borings drilled during the investigations at the site support the soil description provided above with one exception, a distinct fragipan was apparently not encountered in any of the borings.

3.1.2 Bedrock

The bedrock unit lying directly below the soil at the site is a cherty dolomite of the Ordovician age Roubidoux Formation. The Roubidoux Formation is generally 130 to 150 feet thick and consists of cherty dolomite, chert, and sandstone. The formation has entire layers of hard, brittle chert. In Camden County the Roubidoux has less sandstone than in counties further south. Beneath the Roubidoux is the Ordovician age Gasconade Dolomite 290 to 330 feet thick (which includes the 15 to 20 feet thick Gunter Sandstone Member at its base), the Cambrian age Eminence Dolomite 300 to 350 feet thick, and underlying the Eminence Dolomite are Precambrian granites and gneiss.

Depth to bedrock at the site reportedly varies from approximately 1 to 10 feet below ground surface (bgs). Actual depth to bedrock is approximately 4 to 10 feet bgs. The borings in which bedrock was encountered at a depth of less than 4 feet were located in the sump of the in-line degreaser, the base of which is approximately 4 feet bgs.

3.2 Hydrogeology

The occurrence of perched water tables in the Lebanon silt loam are common during the winter and spring months. The perched water tables occur at the fragipan in some areas and at the soil/rock interface in most areas. Groundwater at the soil/rock interface is of insufficient volume and duration to yield amounts viable for domestic use.

The monitoring wells at the site have reported static water levels ranging from approximately 140 to 150 feet bgs in MW-1 and approximately 160 to 175 feet bgs in MW-2. The wells were completed to total depths of 161 feet bgs and 197 feet bgs for MW-1 and MW-2, respectively. This groundwater zone is reportedly the first encountered groundwater beneath the perched zone at the soil/bedrock interface. Based upon available geologic information it appears that the on-site wells are completed in the base of the Roubidoux Formation or the top of the Gasconade Dolomite.

The City of Camdenton water supplies wells are completed in the deeper Eminence Dolomite and Gunter Sandstone. The nearest well to the site is City well number 6, located approximately 700 feet south. This well has a reported total depth of 900 feet and is cased to a depth of 400 feet. The well is the newest well in the City network, it was drilled in 1986. The reported static water level is 95 feet bgs and the reported yield is approximately 100 gallons per minute (gpm). Private water supply wells (outside the City limits) are typically completed at depths ranging from 150 to 400 feet (lower Roubidoux Formation and upper to lower Gasconade Dolomite) and exhibit yields of 10 to 15 gpm.

Analytical data from all city wells obtained from the MoDNR Public Drinking Water Program (PDWP) indicates that all VOCs are below detectable levels.

4.0 SCOPE OF WORK

The purpose of the work to be performed, the approach to be applied in performing the work, and the actual activities to be conducted in completion of the work are presented in the following subsections. The anticipated activities include:

- Installation of one on-site groundwater monitoring well;
- Continued quarterly sampling of the on-site groundwater monitoring wells;
- Removal of the impacted soil in an area of elevated lead concentrations;
- Installation of additional soil borings to assess rate and extent in an area where VOCs are present in the soil; and,
- Preparation of a final closure report for the project.

A Health and Safety Plan (HASP) incorporating health and safety protocol for all field activities is presented as Appendix A. The HASP includes emergency telephone numbers, summarizes emergency activities, and provides directions and a route map to the nearest emergency medical facility.

4.1 Installation of One Groundwater Monitoring Well

Purpose

The purpose for the installation of an additional monitoring well is two-fold: 1) a third monitoring well will allow for determination of groundwater flow direction, and 2) it will provide an additional sampling point for chemical analysis of the groundwater. Water well completion data was requested and obtained from the MoDNR Department of Geology and Land Survey (DGLS). The hope was to identify a well in close proximity to the site that was completed in the same zone. If such a well had been identified, groundwater flow direction could have been determined without the installation of an additional well. Unfortunately, the

well data did not reveal a well located in close proximity to the site that was completed in the shallower zone of interest (Roubidoux Formation).

Approach

The two existing on-site monitoring wells are located on the west and east sides of the building respectively. The wells are completed at depths of 161 feet (MW-1) and 197 feet (MW-2). Groundwater is present in these wells at depths ranging from 140 to 150 feet in MW-1 and 160 to 175 feet in MW-2. Monitoring well completion information was not made available to Modine from MoDNR; however, completion data was obtained from the contracted drilling company (Layne-Western). This data indicated that both wells were halted at encounter of first water.

The proposed monitoring well will be installed near the southwest corner of the site building (Figure 1). The location is suspected to be downgradient from any potential on-site source and will form a triangle with the two existing wells in order to calculate groundwater flow direction. The proposed well will be designated MW-3 and is the only well proposed for the site. Total depth of the proposed well will be no greater than 200 feet. If our assumption of groundwater flow direction is inaccurate and flow is actually in a northerly direction (very unlikely), an additional well installed in the true downgradient direction will be required by MoDNR. A determination of groundwater flow direction will be made in the field prior to dismissing the drilling rig. This way if another well is required, it can be completed without an additional mobilization of equipment and personnel.

Field Activities

The well will be installed in accordance with the Missouri Well Construction Rules 10 CSR 23-4.060. We anticipate that the well will be an open-hole completion. Surface casing will be installed from ground surface to a depth of 10 feet into competent bedrock, the surface casing will be grouted in place, and the hole re-entered and air drilled to a depth of first encountered water within the bedrock. Written approval for an open-hole completion must be obtained in advance of drilling from MoDNR DGLS. A written request has been submitted to DGLS for approval. Based upon our understanding of the site geology, we do not anticipate any problems with obtaining approval for this type of completion.

Prior to installation of the additional on-site groundwater monitoring well, the two wells currently on-site will be gauged to assess groundwater levels in both of the wells. We believe it is unnecessary to re-enter the existing well that was apparently not drilled straight.

The well will be developed in accordance with the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD) Section 3.4 guidelines to ensure that relatively sediment-free water samples will be obtained. Sampling of this well is covered in the following section (Section 4.2 - Quarterly Sampling of the On-site Groundwater Monitoring Wells).

A registered land surveyor will be contracted to survey in the location of the monitoring well both horizontally and vertically. Elevations will be recorded for the ground surface and top of casing (TOC). Survey data will be tied into USGS benchmarks. Surveying will be conducted immediately following completion of the well.

Prior to beginning drilling activities the drill bit, drill rods, and back of the drilling rig will be decontaminated with a high pressure hot water wash prior to the drilling of each new borehole. The washing will be conducted in a decontamination area specifically constructed for this purpose. The decontamination area will be of sufficient size to contain two rounds of decontamination. It will be constructed with wood sides and double lined with plastic. The preferred location would be a paved depression or low lying area. Accumulated decontamination water will then be pumped to 55-gallon drums for storage and proper future disposal.

No soil sampling of this well will be conducted during advancement through the non-lithified material.

4.2 Quarterly Sampling of the On-Site Groundwater Monitoring Wells

Purpose

The continued quarterly sampling of the two existing wells, along with the new well installed as part of this scope of work, over the next two quarters should provide sufficient data to illustrate that the TCE concentrations in the groundwater are consistently below the Drinking Water MCL of 5 ppb.

The two existing wells at the site have only been sampled three times with the following TCE results:

WELL ID	JULY 1992	DECEMBER 1994		FEB 1995
	MoDNR	MoDNR	MODINE	MODINE
MW-1	<5	6.9	6.1	<5
MW-2	<5	<5	<5	<5
MW-2 Duplicate	<5	5.1	Not Collected	<5

* results (presented in ppb)

It should be noted that an entire VOC scan was conducted each time (EPA Method 8010) and all other parameters were below detectable levels.

We expect that this continued monitoring will be the only post closure activity necessary and that Modine will be released from interim status as a TSD by the time monitoring is complete.

Approach

All three on-site monitoring wells, the two existing and the one proposed under this scope of work, will be sampled as part of this scope of work. We anticipate the field activities associated with this scope of work will be implemented in July, 1995. The wells will then be sampled quarterly (once every three months). Samples will be collected in October, 1995 and January, 1996. If at that time one or more of the samples collected during a monitoring event has exceeded the 5 ppb MCL, MoDNR will be consulted and an additional agreed upon action may be necessary.

Field Activities

Prior to sampling, the three wells will be gauged to assess groundwater levels and determine the volumes of water to be purged to adequately purge the wells. The monitoring wells will be purged in accordance with RCRA Ground-Water Monitoring TEGD guidelines. The purging will be conducted by removing a minimum of three well volumes of fluid. Purging will continue until consecutive temperature, specific conductance, and pH have stabilized (within 10% over a minimum of two successive well volumes). These parameters will be measured with a portable field meter which will be calibrated with commercial buffer solutions. Purge water will be containerized in 55-gallon drums and stored on location for proper future disposal. The wells will be purged with a weighted disposable dedicated bailer.

Groundwater samples will be collected in accordance with RCRA Ground-Water Monitoring TEGD guidelines using a dedicated, disposable, polyethylene bailer. The bailer will be attached to a new poly-rope and lowered slowly into the well to minimize agitation of the standing water. Samples will be transferred from the bailer to the sample containers in a manner as to minimize agitation and aeration. Personnel conducting the groundwater sampling will wear clean disposable protective gloves. Clean plastic sheeting will be placed around the well during sampling in case of spillage and to prevent the bailer and rope from touching the ground or other potentially impacted surfaces.

In addition to the two samples collected from the groundwater monitoring wells, a duplicate sample from the same bailer load will be collected from MW-2 and an equipment blank will be collected from one of the new dedicated bailers prior to use. The equipment blank will

be collected by filling an un-used new bailer with laboratory supplied deionized water and transferring the water from the bailer to the sample container. A trip blank, prepared by the analytical laboratory, will accompany the samples in the shipment to assess cross contamination during transport.

The groundwater and quality assurance samples will be analyzed for VOCs by EPA Method 8010. Groundwater samples will be placed in clean laboratory supplied 40 milliliter glass Volatile Organic Analyses (VOA) vials with teflon septas. The vials will be placed in sealed plastic bags and placed on ice in coolers. Samples will be re-iced and securely packed to protect against damage during shipping. These shipping coolers will then be sealed with custody seals and shipped via an overnight delivery service to the analytical laboratory under proper Chain-of-Custody (COC).

The procedures presented in this section will be adhered to for each quarterly groundwater sampling event. At present, extraction of samples from MW-2 is reportedly quite difficult, but possible. Since the well is completely cased, it appears the well was not drilled straight and thus restricts access to the entire length of the borehole for certain types of sampling devices. If at some point during future quarterly sampling events it becomes impossible to continue to retrieve samples from MW-2, it may become necessary to re-enter and recondition this well.

4.3 Remediation of Lead Impacted Soil

Purpose

A lead impact (1,400 ppm) was observed at a very shallow depth (0-2 feet) at boring B-11. All other soil samples from surrounding borings exhibited lead concentrations below background levels of 240 ppm. This includes lead concentrations in boring B-10 located approximately 10 feet northwest of B-11. Though lead was not identified as a constituent previously stored at the facility, MoDNR has requested that Modine address the elevated lead concentration. Based upon the shallowness of the elevated lead concentration encountered and the apparent limited areal extent, it has been determined that excavation and disposal of the impacted soil in the immediate area of B-11 would be the most efficient way in which to satisfy closure requirements.

Approach

Excavation activities will begin with the removal of soil to a depth of three feet and encompass an areal extent of three feet in all directions from boring B-11. At this point, one sample will be collected from the base of the excavation and one sample will be collected from each of the four walls. The samples collected will be analyzed for total lead concentrations (EPA Method 6010) on an expedited turnaround time (24 hour). The excavation will be left open pending receipt of the analytical results. Based upon the results, additional excavation may be necessary. It is anticipated that an excavation of this size will be sufficient; however, if additional excavation is required it will be conducted in one foot lifts until laboratory analysis indicates that background lead levels (240 ppm) have been obtained.

Field Activities

Soil samples will be collected using a decontaminated stainless steel trowel. The trowel will be decontaminated between each sample acquisition by washing with an Alconox® detergent wash, a 10% nitric acid rinse, a potable water rinse, and a distilled water rinse. Spent nitric acid solution will be containerized in a DOT approved 5-gallon bucket for proper future disposal. Excavation equipment will be decontaminated prior to and upon completion of excavation activities with a high pressure hot water wash. The washing will be conducted in a decontamination area temporarily constructed for this purpose. The decontamination area will be of sufficient size to contain two rounds of decontamination. It will be constructed with wood sides and double lined with plastic in a low lying paved area. All decontamination water generated will be drummed and sampled for proper future disposal.

An equipment blank from a distilled water rinse of the sampling trowels will also be collected and submitted to the laboratory for lead analyses. The blank will be collected by pouring distilled water over the sampling trowel and directly capturing the run-off in a sampling jar.

Samples will be placed in clean laboratory supplied sample jars, the lids will be sealed with tape, and the jars will be placed in sealed plastic bags. The jarred samples will then be placed on ice in coolers. Samples will be re-iced, securely packed to protect against damage

during shipping. The shipping coolers will be sealed with custody seals, then shipped via an overnight delivery service to the analytical laboratory under proper COC.

A sample will also be collected of the stockpiled material for disposal profiling. It is anticipated that the excavated soil will be able to be disposed via a permitted landfill as a special waste. However, if the material fails the Toxicity Characteristic Leaching Procedure (TCLP) test for lead, thus determined to be characteristically hazardous, the material will be properly profiled and disposed at an appropriate hazardous waste disposal facility.

4.4 Assessment of Rate and Extent of Volatile Organic Compounds in Soil

Purpose

The MoDNR Hazardous Waste Program (HWP) requires that a determination of rate and extent of contamination be ascertained for proper closure of all TSD facilities. To determine rate and extent, MoDNR requires that soil samples be collected at some distance from an area of impact where analysis indicates concentrations are less than or equal to background levels both laterally and vertically. This is required even in cases, like Modine, where Any Use Levels have not been exceeded. The purpose is to illustrate that contaminants present in site soil have not migrated off-site.

Once no off-site migration is illustrated, a deed notification can be filed stating that hazardous waste has been managed on-site. A survey plat illustrating the extent of VOCs on the west side of the property will also need to be filed as part of the deed notification, in order to document the residue left in place. It is our understanding that if a deed notification is filed and filing certification obtained from the Recorder of Deeds, no additional post closure activities will be necessary and an eventual release from interim status will be obtained.

Approach

A telephone conversation with Ms. Darleen Westcott of MoDNR indicated that the areas of concern lie west (originally the down surface gradient direction) of borings B-3 and B-4 which were drilled by Law Environmental in October 1994. Areas of concern in particular are those extending southwest along the stormwater drain beyond B-4 and west-northwest of B-3. Based

upon this rationale, an additional area of concern would also be present southwest of boring B-1. Ms. Westcott indicated that VOCs were the only constituents with which MoDNR is concerned; therefore, soil samples collected will only be analyzed for VOC's by EPA Method 8010.

Three proposed borings will be drilled in the following locations: proposed boring B-12 located west-northwest of former boring B-3; proposed boring B-13 located west-southwest of former boring B-4 near the end of the stormwater drain line; and proposed boring B-14 located south-southwest of former boring B-1. Proposed boring locations are presented in Figure 1. If VOCs are detected during field screening using a photoionization detector (PID), a proposed step-out boring (B-15) will then be advanced further south-southwest of proposed boring B-14. No additional borings will be necessary west of proposed borings B-12 and B-13, because monitoring well MW-1 is located in the area where any step-out would be located and the analytical results obtained from soil samples collected in drilling this well did not indicate the presence of VOCs. These results would therefore be used to assess the VOC extent to the west.

Field Activities

Soil borings will be drilled using a truck-mounted hollow-stem auger drilling rig. Hollow-stem augers are the typical type of powered auger used when soil sampling is being conducted. The hollow-stem auger comes in various diameters and consists of a section of seamless steel tube with a spiral flight and a center drill stem. The lead auger has a finger-type cutter head attached at the bottom. The center drill stem is composed of drill rods to which are attached a center plug with a drag bit at the bottom. When continuous sampling is being conducted, the center bit is replaced with a continuous core sampler as described in the next paragraph. As the borehole is advanced, additional five feet lengths of hollow-stem flights and center rods will be added. To allow for split spoon sampling, the center rod and plugs will be removed and samples collected as described in the next paragraph.

Soil samples will be collected continuously from each boring using either a five feet long continuous core soil sampler or a two to two and one-half feet long split spoon sampler. The method of sampling used will depend on the lithologic conditions encountered. In areas where abundant chert is present in the subsurface soils, a continuous core soil sampler is ineffective. Both the continuous core soil sampler and the split spoon sampler will be advanced ahead of the augers to ensure collection of undisturbed soil samples.

All boreholes will be filled with a cement-bentonite slurry after sampling is completed. If the boring is located in a paved area, the pavement will be appropriately patched with concrete or asphalt after the slurry has set-up and the borehole topped-off.

The location of each soil boring will be marked and a registered land surveyor contracted to survey in the locations both horizontally and vertically. Survey data will be tied into USGS benchmarks. Surveying will be conducted following completion of all drilling and sampling activities.

The hollow stem augers and the back of the drilling rig will be decontaminated with a high pressure hot water wash prior to the drilling of each new borehole. The washing will be conducted in a decontamination area specifically constructed for this purpose. The decontamination area will be of sufficient size to contain two rounds of decontamination. It will be constructed with wood sides and double lined with plastic. The preferred location would be a paved depression or low lying area. Accumulated decontamination water will then be pumped to 55-gallon drums for storage and proper future disposal.

Samples will be field screened using a PID capable of measuring the off-gassing of VOCs. The sample exhibiting no presence of VOCs from the greatest depth will be selected for laboratory analyses. It is anticipated that only one sample will be submitted from the soil borings located at the greatest distance from the potential source.

4.5 Final Closure Report

A final closure report for the TSD facility will be issued at the close of field activities in accordance with the schedule outlined in Section 5.0 of this work plan.

The closure report will include the following:

- a discussion of the results obtained from the work conducted under this scope of work, excluding subsequent rounds of quarterly monitoring. It is anticipated that final closure can be obtained with on-going quarterly monitoring (for two quarters) as a contingency;

- findings of the previously discussed risk assessment analysis of the soil conducted in August 1994, which indicated that no health risk was posed by the minimal amounts of VOCs in the soil; and

- all information related to the deed notification stating that hazardous waste has been managed on site.

The closure report will be signed and sealed by a registered Professional Engineer in the State of Missouri as required by MoDNR.

5.0 PROJECT SCHEDULE

It is estimate that the field activities (monitoring well installation, groundwater sampling, advancement of soil borings, and soil remediation) can be completed in approximately one week. Laboratory turnaround time for the groundwater and soil samples submitted to an off-site analytical laboratory will take approximately four weeks. The final closure report, which will include a description of field activities, will be completed within three weeks of receipt of the analytical results. Prior to submittal of the report, Modine is requesting a meeting with MoDNR to present the findings and obtain oral comments. The purpose of the meeting will be to attempt to address subsequent requirements prior to final closure. It is estimated that one to two weeks will be required to incorporate MoDNR's oral comments prior to final submittal to MoDNR. Groundwater monitoring will continue quarterly over the next two quarters. Results of each quarterly monitoring event will be summarized in a letter to MoDNR.

6.0 REFERENCES

Groner, A.H./Missouri Department of Natural Resources, Division of Environmental Quality. Letter dated June 16, 1994, to Mr. Thomas S. Sanicola/Modine Manufacturing Company regarding Modine's request to demonstrate a risk based heat transfer storage facility closure.

Heimericks, G.W./Missouri Department of Natural Resources. Letter dated November 12, 1992, to Mr. Don Mans/Modine Heat Transfer, Inc. regarding closure Plan approval for Modine Heat Transfer, Inc.

Jacobs Engineering Group, Inc.. 1992. *Visual Site Inspection and Preliminary Assessment,* Modine Heat Transfer, Inc.. VSI/PA conducted on behalf of the U.S. Environmental Protection Agency Region VII March 4, 1992.

Law Engineering and Environmental Services. 1991. *Environmental Site Assessment, Modine Heat Transfer, Inc.* Consulting report prepared for Modine Manufacturing Company November 1991.

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Law Engineering and Environmental Services. 1993. *Revised Environmental Site Assessment, Modine Heat Transfer, Inc.* Consulting report prepared for Modine Manufacturing Company August 1993.

Law Engineering and Environmental Services. 1994. *Environmental Risk Assessment of Former Drum Storage Areas, Modine Heat Transfer, Inc.* Consulting report prepared for Modine Manufacturing Company August 16, 1994.

Law Engineering and Environmental Services. 1995. *Report of Groundwater Sampling Event, Modine-Camdenton, Missouri Facility.* Consulting report submitted to Modine Manufacturing Company March 28, 1995.

Middendorf, M.A., K.C. Thomson, G.L. Easson, and H.S. Sumner. 1991. *Bedrock Geologic Map of the Springfield 1°x 2° Quadrangle, Missouri.* Miscellaneous Investigation Series Map 1-2029.

Sanicola, T.S./Modine Manufacturing Company. Letter dated February 14, 1992, to Mr. Daniel M. Techirgi/Department of Natural Resources Hazardous Waste Permits Unit regarding the revised and updated Closure Plan for the interim storage units.

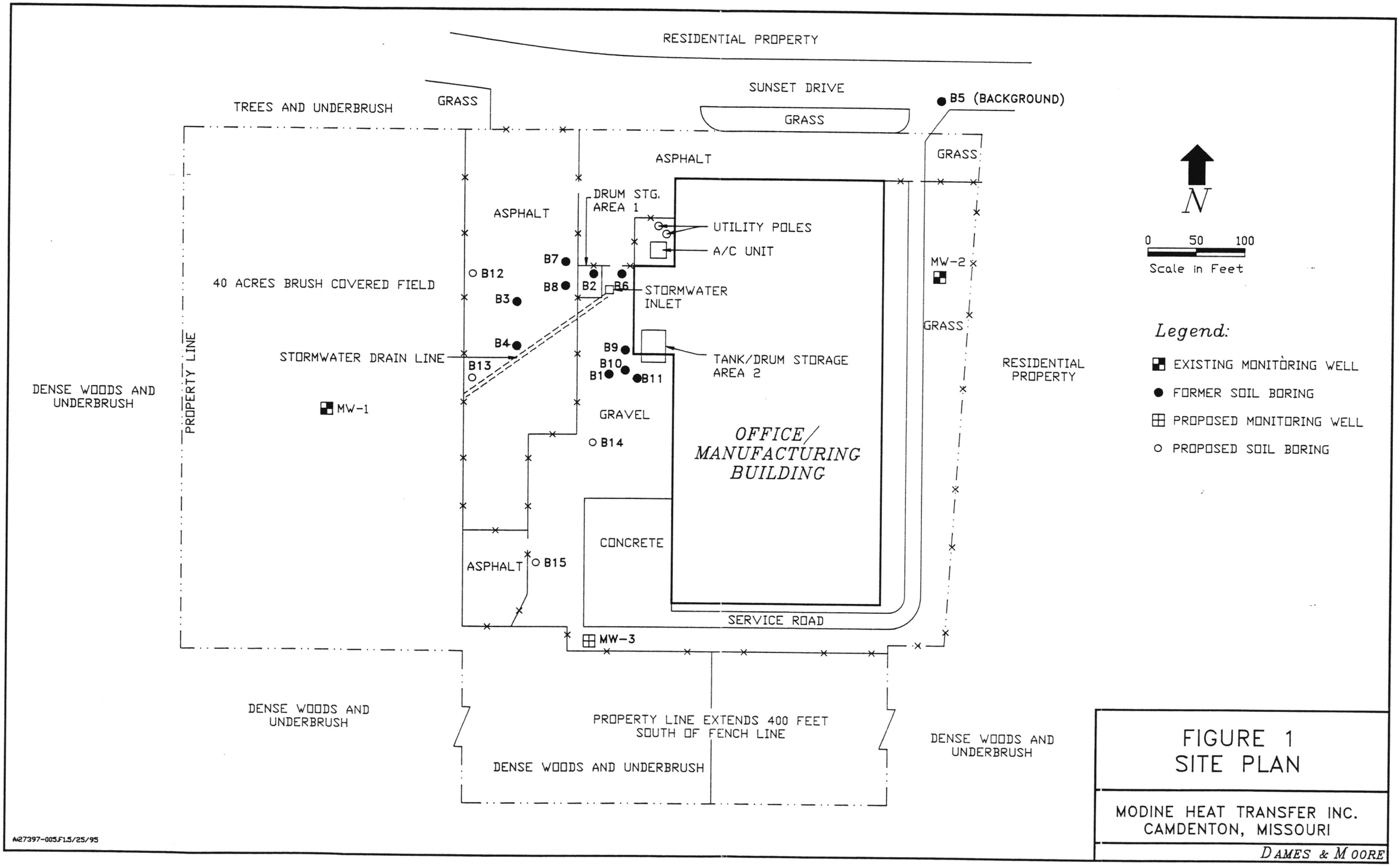
Sanicola, T.S./Modine Manufacturing Company. Letter dated September 9, 1993, to Mr. Daniel M. Techirgi/Missouri Department of Natural Resources Hazardous Waste Program regarding analytical results for the Modine Heat Transfer, Inc. interim status TSD facility.

Sanicola, T.S./Modine Manufacturing Company. Letter dated March 15, 1994, to Mr. Arthur H. Grover/Missouri Department of Natural Resources Division of Environmental Quality in response to the MoDNR letter regarding the closure of the Modine Heat Transfer, Inc. storage facility in Camdenton, Missouri.

Sanicola, T.S./Modine Manufacturing Company. Letter dated February 17, 1995, to Ms. Darleen Westcott/Missouri Department of Natural Resources Hazardous Waste Program regarding the pre-purchase Phase I assessment and analyses, explanation of 1992 1,1,1-Trichloroethane spill and ongoing sampling analytical results, and Jacobs Engineering report.

U.S. Department of Agriculture Soil Conservation Service. 1994. *Soil Survey of Camden County, Missouri.*

FIGURE



A27397-005.F1.5/25/95

FIGURE 1
SITE PLAN

MODINE HEAT TRANSFER INC.
CAMDENTON, MISSOURI

DAMES & MOORE

APPENDIX A
HEALTH AND SAFETY PLAN

DAMES & MOORE
HEALTH AND SAFETY PLAN

Modine Manufacturing Company
Final Closure of Interim TSD Facility
Camdenton, Missouri

FOR
Modine Manufacturing Company

Part I
SITE SPECIFIC PROCEDURES SECTION

Part II
GENERAL PROCEDURES SECTION

D&M Job No. 27397-005-045
May 31, 1995

TABLE OF CONTENTS

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1.0 PURPOSE

The purpose of this Health and Safety Plan (HSP) is to assign responsibilities, establish personnel protection standards and mandatory safety practices and procedures, and provide for contingencies that may arise during site operations. This Plan must be read prior to going into the field to ensure proper planning (e.g., availability of equipment, etc.).

The Dames & Moore Health and Safety Plan consists of two parts. Part 1 addresses site-specific procedures and Part II addresses standard health and safety procedures. **Both Parts I and II of this Health and Safety Plan must be on site during all field activities.** The Standard Procedures section (Part II) addresses general procedures that apply to virtually all field activities involving hazardous substances or wastes. The site-specific section (Part I) addresses items that are specific to this particular field activity.

Text, tables, figures, and appendices designations are preceded in the Standard Section by the letter "G" and in the Site-Specific Section by the letter "S" (e.g., Page G-23, Table G6-1, Figure S6-1, Appendix S-A, etc.).

In addition to this Health and Safety Plan (parts I and II), the following additional documents must be included in this Plan by the local office prior to the start of field work:

Training/Medical records for all on-site employees:

- HAZWOPER 8 Hour Refresher Certificate (Current - i.e, within last 12 months);
- HAZWOPER 8 Hour Supervisor Certificate (for Class 1 employees);
- Medical Clearance Certificate (e.g., Summary Profile from last annual/biennial physical);
- First Aid/CPR Certification (Current).

For those who may be required to wear an air purifying respirator:

- Current Respirator Fit Test Record (Current);
- Medical Clearance to wear a respirator (this is normally noted on the Summary Profile for the annual physical).

Finally, it may be necessary to make additional copies of some of the forms prior to going into the field. The following forms may require additional copies:

- Plan Acceptance Form (Form 9);
- Site Safety Briefing Form (Form 6);
- Air Monitoring Log (Form 5);

The following approval page (Section 2.0) must be signed and dated by all parties prior to mobilizing to the field.

2.0 APPROVALS

Project Name and Number:	Modine Manufacturing Company Dames & Moore Job No. 27397-005-045
Project Site Location:	Sunset Drive Camdenton, Missouri
D&M Project Manager (PM):	Dan Price (SGF)
D&M Site Safety Officer (SSO):	Dan Price
D&M H&S Plan Preparer:	Thomas M. Covilli, CIH (STL)
D&M H&S Plan Reviewer:	Dan Price
Preparation Date:	May 31, 1995
Expiration Date:	**July 31, 1995**

APPROVED:

D&M Division Health and Safety Manager (DHSM)

Thomas M. Covilli 5/31/95

(Signature and Date)

D&M Project Manager (PM)

6/1/95

(Signature and Date)

96STL - 007

Plan Health and Safety Approval Number

3.0 GENERAL INFORMATION

3.1 OBJECTIVES

The objective of this field effort is to determine groundwater flow direction and to provide another sampling point for chemical analysis of the groundwater.

3.2 STATUS OF BACKGROUND REVIEW

Complete: __ Preliminary: X

3.3. PROPOSED DATE OF INVESTIGATION

This project is tentatively scheduled to commence on July 10, 1995, and last approximately one week.

4.0 FIELD PERSONNEL

The field team will consist of the following persons:

Project Manager:	Dan Price (SGF)
Site Safety Coordinator:	Dan Price
D&M Field Personnel:	Dan Price

5.0 SITE SUBCONTRACTORS

The following Dames & Moore subcontractors will be working on site:

Layne-Western - Drilling; and,
Sunbelt Environmental - Excavation

Dames & Moore will insist on the following health and safety requirements from its subcontractors:

- Subcontractor employees must have appropriate training [i.e., either a 40-hour or 24-hour OSHA-required (29 CFR 1910.120) health and safety course for hazardous waste work, or certified equivalent training].

- Personnel working at hazardous waste sites must have had an annual physical (or physician's waiver for biennial physical) and be certified "fit for duty" and "fit for respirator use," if necessary, by a qualified physician.

- Dames & Moore will insist on obtaining proof of both training and a physical before site work may begin.

- Personnel must have appropriate personal protective equipment (PPE) for the specific job. At a minimum, personnel should have the following equipment, which will be inspected by Dames & Moore:

  - Hard hat
  - Safety shoes
  - Gloves
  - Goggles/safety glasses
  - Hearing protection, if appropriate
  - Respiratory protection, if appropriate (with fit test)
  - Other equipment as specified by the HSP.

- All equipment and field operations must meet applicable safety standards.

Before field activities begin, the subcontractor must develop a site-specific HSP. The subcontractor must agree to comply with at least the minimum requirements of its own site-specific HSP, be responsible for the health and safety of its own employees, and sign the Subcontractor Statement of Compliance Form (Form 1) for all on-site employees before site work begins. The subcontractor also must agree that it will take any additional measures it deems necessary to meet at least minimum applicable health and safety standards if unforseen circumstances arise.

The subcontractor will provide at least minimum safety equipment as required by the site-specific HSP. When respirators are necessary, the subcontractor will provide a respirator fit test certificate and a physician's "fit for respirator use" declaration.

6.0 SITE DESCRIPTION

6.1 SITE LOCATION

The site is located at Sunset Drive, Camdenton, Missouri (T 38N, R 17W, Section 26).

See Figure S6-1, Site Location Map.

6.2 SITE DESCRIPTION

The Modine Heat Transfer, Inc. Site occupies approximately 100 acres in Section 26, Township 38 North, Range 17 West in Camden County. The one manufacturing plant at the site occupies approximately 83,000 square feet and has undergone four construction additions through its history (1971, 1973, 1979, 1983).

Operations began at the site in 1967 under the ownership of Dawson Metal Products. Sunstrand Tubular Products purchased the site in 1974 and operated it until 1990. Modine Heat Transfer, Inc., a wholly owned subsidiary of Modine Manufacturing Company, purchased the site in October 1990. The site has always been utilized in the manufacture of aluminum and copper coils and feeder parts used in the manufacture of heat transfer products.

In Response to an alleged 4,500 gallon release of spent solvent filed with Missouri DNR, Modine was requested to conduct and environmental site assessment at the facility. Five borings were installed in November 1991and the subsequent soil sample results indicated low (less than 1 ppm) volatile organic compound (VOC) concentrations in the near surface on the west side of the building. Within the building, 1,1,1-trichloroethane (TCA) was detected at a concentration of 200 ppm and trichloroethene (TCE) at a concentration of 3 ppm.

A subsequent investigation by the MO DNR showed minor (less than 1 ppm) TCE concentrations in the boring for monitoring well MW-2. The groundwater samples collected did not exhibit any VOC concentrations above detectable levels: thus, no further action was at that time deemed necessary.

Additional subsurface soil sampling was conducted in Area 1 and Area 2 and the results indicated VOC concentrations less than 0.1 ppm and one elevated lead concentration of 1,400 ppm adjacent to Area 2.

A spill of approximately 1,675 gallons of TCA occurred in early 1992 from a monorail degreaser into the machine pit/containment sump; 1,469 gallons were recovered (i.e., 206 gallons were lost and are attributable primarily to volatilization).

Subsequent groundwater sampling has been conducted with no appreciable differences compared to earlier sampling efforts.

6.3 UNUSUAL SITE FEATURES

No unusual site features are listed in the supporting documentation.

7.0 DESCRIPTION OF WORK AND HAZARD EVALUATION

7.1 DESCRIPTION OF SITE WORK

Dames & Moore Personnel will provide construction management and environmental services related to the field work at the above mentioned site. Specifically, this will involve the following tasks:

- Installation of one on-site groundwater monitoring well;
- Continued quarterly sampling of the on-site groundwater monitoring wells;
- Removal of the impacted soil in an area of elevated lead concentrations; and,
- Installation of additional soil borings to assess rate and extent in an area where VOCs are present in the soil.

Decontamination will be conducted in accordance with procedures outlined in Part II Subsection 7.0 - Decontamination. Tool decon will be conducted with Alconox and/or hexane as prescribed. Disposable tools will be used wherever applicable.

Drilling investigations will be conducted in accordance with Part II Subsection 10.3 - Drilling Safety.

Excavation activities will be conducted in accordance with Part II Subsection 10.4 - Excavation, in general. For the purposes of this project, Dames & Moore employees will not enter excavations.

Dames & Moore employees will be prohibited from entering confined spaces under this Health and Safety Plan.

7.1.1 Work Limitations

In general, field work will be conducted during daylight hours only. At least two personnel will be in the field at all times. The Project Manager or Division Health and Safety Manager must grant special permission for any field activities conducted beyond daylight hours.

7.2 WASTE TYPES POTENTIALLY ENCOUNTERED

Liquid: X Solid: X Sludge: __ Gas: __
Vapor:X

The individual soil and/or groundwater contaminants found in previous investigation are listed below:

- Lead
- Trichloroethene (TCE)
- 1,1,1-Trichloroethane (TCA)
- VOCs

7.3 CHARACTERISTICS OF WASTE

Corrosive: __	Ignitable: X	Radioactive: __
Volatile: X	Toxic: X	Reactive: __
Unknown: __		

7.4 CHEMICAL AND PHYSICAL PROPERTIES OF HAZARDOUS SUBSTANCES

The exposure limits, recognition qualities, acute and chronic effects, and first aid treatments for hazardous chemicals expected to be found at the site are presented in Tables S7-1 (Exposure Limits and Recognition Qualities) and S7-2 (Health Hazards and First Aid).

7.5 INITIAL LEVEL OF PROTECTION

This project will be conducted using the following initial level of protection:

Level A ___ Level B ___ Level C ___ Level D X

Level of Protection	Protective Equipment Ensemble
D	Coveralls or work clothes • Impermeable coveralls required when in contact with waste materials: - **PVC**, or - **Polycoated Tyvek** Work gloves (as needed) • Impermeable gloves and inner gloves required when in contact with waste materials: - **PVC** (inner) - **Nitrile** (outer) Safety boots, leather, steel toe • **Rubber (latex) overboots** for incidental contact with waste materials to protect leather work boots -or- • **16 inch PVC boots** with steel toe and shank for extended contact Safety glasses

- **Splash goggles** required for incidental eye contact with liquid chemicals or contaminants

Hard hat

Hearing protection when in proximity to heavy equipment or other noise generating sources

Orange safety vest

C

Air purifying respirator (half face or full face) with **HEPA, Organic Vapor/Acid Gas** cartridges

Chemical resistant coveralls

- **PVC**, or
- **Saran** disposables

Hard hat

Inner and outer chemical resistant gloves (**PVC** inner and **Nitrile** outer)

16 inch **PVC** boots with steel toe and shank, or

- Leather boots, steel toe with rubber outer boots

Full face air purifying respirator with combination **HEPA/Organic Vapor/Acid Gas** cartridges

Hearing protection when in proximity to heavy equipment or other noise generating sources

Orange safety vest

The types of monitoring instruments used, as well as the action levels to upgrade personal protection are shown on Table S7-3, Hazard Monitoring Methods, Action Levels, and Protective Measures.

7.6 SITE CONTROL

To prevent the accidental spread of contaminants, as a minimum, three zones will be delineated on the site:

Exclusion Zone (EZ)	The exclusion zone(s) will encompass the drilling locations and areas where remedial excavation will take place. Each area will be demarcated with red **"DANGER - DO NOT ENTER"** barrier tape. Only authorized personnel may enter this area wearing the specified level of protection.
Contamination Reduction Zone (CRZ)	The contamination reduction zone will consist of a lane into and out of the EZ which will adequately accommodate decontamination station(s) as necessary. Access and egress for each EZ will only be allowed through the CRZs. Only authorized personnel wearing the specified level of protection may enter this area.
Support Zone (SZ)	The support zone will be located beyond the CRZ and will include the remaining portions of the site. No specific project-related personal protective equipment (PPE) is required in this zone.

Refer to Part II Subsection 4.0 for additional details.

7.7 SUMMARY OF OVERALL HAZARD

Serious: __	Moderate: X
Low: __	Unknown: __

7.8 HAZARDS ANALYSIS FOR SITE TASKS

7.8.1 Chemical Hazards

Low levels of contaminants listed in Subsection 7.3 may be present in soils and groundwater.

7.8.2 Fire and Explosion Hazards

The potential for encountering soils saturated with product or free liquid contamination is low; consequently, the fire and explosion hazard is low for this project.

Nonetheless, all possible sources of ignition should be eliminated within the Exclusion Zone.

Gasoline and LP gas are very flammable and, if used, must be handled safely. Most fuel gases and vapors are heavier than air and may accumulate in low lying areas under certain conditions.

7.8.3 Physical Hazards

Physical hazards such as slips, trips, and falls may occur. Workers must walk cautiously at a site to avoid tripping, especially when uneven terrain is present. Falls are more serious when they occur from heights. Extra precautions must be taken if guardrails or railings are absent. Ladders used for access to a high place should be securely lashed or otherwise fastened at the top to prevent sliding and the feet must be on a firm and level base. Workers can be struck by vehicles used at a site. While driving in reverse, the operator usually has a more limited field of view than while driving forward and must observe extra caution. Such vehicles must be equipped with a backup alarm to warn workers that the vehicles are moving in reverse.

Material Handling: Accidents in manual handling of materials are primarily the result of unsafe working habits--improper lifting, carrying too heavy a load, incorrect gripping, or failing to wear personal protective equipment. These may be avoided by testing the weight of an object before attempting to lift and carry it. If it is too heavy, get help, and if possible, use mechanical lifting aids. The proper method for lifting is:

- Get a good footing.
- Place feet about shoulder width apart.
- Bend knees to pick up load. Never bend from waist.
- Keep back straight.
- Get a firm hold. Grasp opposite corners of the load, if possible.
- Keep the back as upright as possible.
- Lift gradually by straightening the legs--don't jerk the load.
- Keep the weight as close to the body as possible.
- When changing directions, turn the entire body, including the feet.
- Don't twist the body.

7.8.4 Biological Hazards

Biological hazards may include venomous snakes, insects, animals (rabid) and allergenic plants. Section 13.0 of Part II should be reviewed by site personnel prior to beginning work.

7.8.5 Electrical Hazards

Utility clearance will be performed prior to any soil penetration activities. The work area will be inspected to verify no possibility of contact with overhead utilities. A buffer zone of at least 20 feet from overhead utilities must be maintained.

Any electrical power tools must be connected to GFCI (ground fault circuit interrupter) protected circuits. All power cords must be inspected for damage prior to use.

7.8.6 Heat Stress

Exposure to high temperatures may occur during field activities. Precautions will be implemented by the SSO as per Part II, Section 10.2. Monitoring procedures as described in Part II, Section 10.2 shall be implemented as required.

7.8.7 Noise Hazards

Hearing protection is required for work performed adjacent to operating heavy equipment or other noise generating sources.

7.8.8 Other Hazards

Dames & Moore staff shall stay out of the operating range of any heavy equipment on site. The "operating range" is defined as the swing zone plus 25 feet. Entry into the operating range is allowed only after the operator's attention has been gained and all buckets or extensions have been grounded.

Dames & Moore employees will not enter any excavations or confined spaces for the duration of this project. Any sampling of soils within areas which have been excavated deeper than 4 feet will be done from the excavator bucket after the operator has grounded the bucket and given authorization for personnel to approach his machine.

Dames & Moore employees will be required to wear orange reflective safety vests when in close proximity to roadways and operating heavy equipment.

7.9 HAZARD COMMUNICATION

The following chemicals will be used on site for this project. Material Safety Data Sheets (MSDSs) are attached to this plan.

Acetone

Alconox	____
Hexanes	____
Isobutylene	X
Trisodium Phosphate Dodecahydrate	X
Ethanol	____
Nitric Acid	X
Portland Cements	____
Other Chemicals To Be Used:	None

7.10 HAZARDOUS MATERIALS SHIPPING

The shipping of identified hazardous materials shall be done in accordance with Part II Section 14.0 - Hazardous Waste Shipping.

8.0 EMERGENCY INFORMATION

8.1 EMERGENCY CONTACTS

Contact	Person or Agency	Telephone No.
Police	Local	911
Fire	Local	911
Ambulance	Local	911
Hospital	Lake of Ozarks General Hospital	314-348-3181
Poison Center		314-348-3181
Client Contact	Tom Sanicola	414-636-1200
D&M Office Project Manager	Dan Price	417-881-3927
D&M Office Safety Coordinator	Elaine Radichel (STL)	314-993-4599
Division H&S Manager	Thomas M. Covilli, CIH or Thomas G. Natsch, CIH (Alt.)	(314) 993-4599
Firmwide H&S Director	Dr. Gary Krieger	(303) 294-9100

8.2 LOCATION OF SITE RESOURCES

Water Supply: Hauled on-site if not available.

Telephone: Mobile cellular telephone required if onsite access is not available.

Toilet: Local, readily available toilets will be used if facilities on-site are not available.

8.3 LOCATION OF HOSPITAL/CLINIC

Lake of Ozarks General Hospital

From site, take Dawson Road north to Missouri Highway 5; turn right toward Camdenton; turn left at U.S. Highway 54 and proceed 12 miles to Osage Beach, Missouri; follow signs to hospital.

8.4 EMERGENCY MEDICAL TREATMENT PROCEDURES AND BLOODBORNE PATHOGEN EXPOSURES

Refer to Part II Section 3.5.4.4 for emergency medical treatment procedures due to on-site injuries or illnesses.

For purposes of this health and safety plan, personnel fall into category B in Dames & Moore's Bloodborne Pathogens Program, which are jobs where required tasks normally do not but could involve exposure to blood, bodily fluids, or tissues--for example, in the event first aid or CPR is required. If exposure to blood, bodily fluids, or tissues occurs, Universal Precautions, such as those outlined in Part II, 3.5.4.5 should be followed to minimize the chance of contracting disease.

OSHA required Bloodborne Pathogens Infection Protection Packs are required on-site for the duration of the project (available through the Office Safety Coordinator).

9.0 MISCELLANEOUS

9.1 POSTING OF OSHA POSTER FOR PRIVATE INDUSTRY FORM (Form 8)

Required ___ Not Required X

9.2 ADDITIONAL REQUIRED EQUIPMENT TO BE TAKEN INTO FIELD

- First aid kit (with eye wash)
- OSHA-required Bloodborne Pathogens Infection Protection Packs (available through the Office Safety Coordinator)
- Instrumentation as specified in Section 9.3 below
- Equipment calibration gas/supplies
- Orange reflective vests
- Barricade tape
- Fire extinguisher - 5lb ABC
- Decon supplies (Alconox, wash tubs, brushes, containers for waste)

9.3 INSTRUMENT CALIBRATION

PID (HNu with a 10.2 ev lamp):	Required X Not Applicable ___
Explosimeter:	Required ___ Not Applicable X
Oxygen Meter:	Required ___ Not Applicable X
Dust Meter:	Required ___ Not Applicable X
Other (specify):	None

9.4 WORKER TRAINING RECORDS

Worker Training Records are required on site. These records are also on file in the Dames & Moore Sacramento, California office.

9.5 FIELD FORMS TO BE USED

Copies of the following forms will be completed in field:

Form 1	Subcontractor Statement of Compliance Form
Form 4	Equipment Calibration Log Form
Form 5	Air Monitoring Data Form
Form 6	Site Safety Briefing Form
Form 9	Plan Acceptance Form

Copies of the following forms will be available with the HSP:

Form 2	Bloodborne Pathogens Incident Evaluation Form
Form 3	Accident/Exposure Report Form
Form 10	Plan Feedback Form (Optional)

9.6 CONFINED SPACE ENTRY PERMIT

Confined space entries will not be allowed by Dames & Moore employees for the duration of this project.

TABLES

TABLE S7-1
EXPOSURE LIMITS AND RECOGNITION QUALITIES

COMPOUND	Exposure Standards			Skin Designation	Recognition Qualities		
	TLV/PEL (a) (ppm)	STEL (b) (ppm)	IDLH (c) (ppm)		Odor/ Threshold (ppm)	LEL (d) (%)	Ionization Potential (ev)
Lead	0.05*	--	700	--	varies	--	--
Trichloroethylene	50.0	200	1,000	--	28	8.00	9.45

*	mg/m^3
+*	Recommended Exposure Limit (Leung, 1988)
+	f/cc
+!	1 f/cc over 30 minutes
!	Ceiling
(a)	The more stringent of either the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) or the American Conference Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV).
(b)	Short Term Exposure Limit - 15 minute exposure.
(c)	Immediately Dangerous to Life and Health.
(d)	Lower Explosive Limit.

TABLE S7-2
HEALTH HAZARDS AND FIRST AID

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Lead	Ingestion Inhalation Contact	Yes	Weakness, lassitude, insomnia, facial pallor, anorexia, low weight, malnutrition, constipation, abdominal pain, colic, anemia, tremors, encephalopathy, hypotension	Gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue
Trichloroethylene	Ingestion Inhalation Contact	Yes	Headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, carcinogenic	Respiratory system, heart, liver, kidneys, central nervous system, skin

NOTE: General First Aid Treatment

Eye:	**IRRIGATE IMMEDIATELY**
Skin:	**SOAP WASH PROMPTLY**
Inhalation:	**MOVE TO FRESH AIR**
Ingestion:	**GET MEDICAL ATTENTION**

TABLE S7-3
HAZARD MONITORING METHODS, ACTION LEVELS, AND PROTECTIVE MEASURES

Hazard	Monitoring Method	Action Level	Monitoring Schedule	Protective Measures
Organic vapors	PID (with 10.2ev lamp)	Up to 5 ppm above background in the breathing zone	Periodically (every 30 minutes) during invasive field activities	Level D
		5-50 ppm	Periodically (every 30 minutes) during invasive field activities	Level C
		>50 ppm	Periodically (every 30 minutes) during invasive field activities	Level B or EVACUATE AREA

FIGURES

FIGURES TO BE INCLUDED
PRIOR TO IMPLEMENTATION OF
FIELD WORK

APPENDICES

APPENDIX S-A

FIELD FORMS

FORM 1

SUBCONTRACTOR STATEMENT OF COMPLIANCE FORM

This is to confirm that the employees listed below are qualified by virtue of training and experience to engage in field activities at _____ _____ located in _____, _____, in connection with the applicable Subcontract Agreement between Dames & Moore and _____ dated _____, 19____. Further, all said employees have been determined to be properly trained and medically fit to perform those activities prescribed by said subcontract and to use the respiratory protective equipment necessary to perform the job safely in accordance with 29 CFR 1910 and 1926 and any other Federal, State, or local requirements.

Employee Names

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

_____
Name of Subcontractor

_____
Signature of Authorized Subcontractor Representative

_____
Printed Name of Authorized Subcontractor Representative

FORM 2

BLOODBORNE PATHOGENS INCIDENT EVALUATION FORM

Employee Name: _____
Office/Location: _____
Date: _____ Time: _____ a.m./p.m.

Circumstances: Supervisor's Assessment of the Following Control Measures Used at the Time of the Exposure (see definition below):

Route of Exposure: _____
_____
_____

Engineering: _____
_____
_____

Work Practice: _____
_____
_____

Personal Protective Equipment: _____
_____
_____

Reason for Failure of the Control Measures or Failure to Comply with Recommended Protective Measures:
_____
_____
_____

Measures Taken to Minimize Reoccurrence of Incident: _____
_____
_____
_____

Supervisor's Signature: _____

Definitions:

Exposure Incident: a specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that result from the performance of an employee's duties.
Engineering Controls: controls (e.g., sharps, disposal containers, self-sheathing needles) that isolate or remove the bloodborne pathogens hazard from the workplace.
Work Practice Controls: controls that reduce the likelihood of exposure by altering the manner in which a task is performed (e.g., prohibiting recapping of needles by a two-handed technique).
Personal Protective Equipment is specialized clothing or equipment worn by an employee for protection against a hazard. General work clothes not intended to function as protection against a hazard are <u>not</u> considered to be personal protective equipment.

FORM 3

ACCIDENT/EXPOSURE REPORT FORM

EMPLOYEE NAME _____ DATE OF BIRTH _____

HOME ADDRESS _____ PHONE NO. _____

SEX: ☐ MALE ☐ FEMALE JOB TITLE _____ SOCIAL SECURITY NO. _____

OFFICE NO. _____ OFFICE LOCATION _____ DATE OF HIRE _____

HOURS USUALLY WORKED: HOURS PER DAY _____ HOURS PER WEEK _____ TOTAL HOURS WEEKLY _____

WHERE DID ACCIDENT OR EXPOSURE OCCUR? (INCLUDE ADDRESS) _____

COUNTY _____ ON EMPLOYER'S PREMISES? ☐ YES ☐ NO

WHAT WAS EMPLOYEE DOING WHEN INJURED? (BE SPECIFIC) _____

_____

HOW DID THE ACCIDENT OR EXPOSURE OCCUR? (DESCRIBE FULLY) _____

_____

_____

WHAT STEPS COULD BE TAKEN TO PREVENT SUCH AN OCCURRENCE: _____

_____

_____

OBJECT OR SUBSTANCE THAT DIRECTLY INJURED EMPLOYEE: _____

_____

_____

DESCRIBE THE INJURY OR ILLNESS _____ PART OF BODY AFFECTED _____

NAME AND ADDRESS OF PHYSICIAN _____

IF HOSPITALIZED, NAME AND ADDRESS OF HOSPITAL _____

DATE OF INJURY/ILLNESS _____ TIME OF DAY _____

LOSS OF ONE OR MORE DAYS OF WORK? YES/NO _____ IF YES - DATE LAST WORKED _____

COMPLETED BY (PRINT) _____ SIGNATURE _____

TITLE _____ DATE _____

Immediately upon learning of the incident, an Accident/Exposure Report Form must be completed by the supervisor or Site Safety Officer and the injured person(s) for submittal to the Project Manager and Office Safety Coordinator. The completed report must then be immediately transmitted to the Regional H&S Manager and the firmwide H&S Director.

FORM 4

EQUIPMENT CALIBRATION LOG FORM

PROJECT NAME: _____ INSTRUMENT: _____

PROJECT NUMBER: _____ SERIAL NUMBER: _____

DATE	PERFORMED/ CALIBRATED BY	HOURS USED	CALIBRATION STANDARD *	INITIAL READING *	CORRECTED READING *	BATTERY CHECK (Y/N)	MAINTENANCE AND REPAIR

*Specify Units

FORM 5

AIR MONITORING DATA FORM

PROJECT NAME: _____ INSTRUMENT USED: _____ PROJECT NUMBER: _____

DATE: _____ SAMPLES BY: _____

CALIBRATION DATE: _____

FIELD ACTIVITIES: _____

BACKGROUND LEVEL: _____ LOCATION: _____

SAMPLE NUMBER	TIME	DURATION (MINUTES)	LOCATION	READING (PPM)	COMMENTS
1					
2					
3					
4					
5					
6					
7					

FORM 6

SITE SAFETY BRIEFING FORM

PROJECT NAME _____ PROJECT NUMBER _____

DATE _____ START TIME _____ COMPLETED _____

SITE LOCATION _____

TYPE OF WORK (GENERAL) _____

SAFETY ISSUES

TASKS (THIS SHIFT): _____

_____

PROTECTIVE CLOTHING/EQUIPMENT: _____

_____

CHEMICAL HAZARDS: _____

_____

PHYSICAL HAZARDS: _____

_____

CONTROL METHODS: _____

_____

SPECIAL EQUIPMENT/TECHNIQUES: _____

_____

NEAREST PHONE: _____

HOSPITAL NAME/ADDRESS: _____

EMERGENCY RESPONSE PLAN REVIEW INCLUDING EMERGENCY EVACUATION ROUTE: _____

_____

SPECIAL TOPICS (INCIDENTS, ACTIONS TAKEN, ETC.) _____

_____

_____

ATTENDEES

PRINT NAME SIGN NAME

_____

_____

_____

_____

_____

_____

MEETING CONDUCTED BY: _____

FORM 9

PLAN ACCEPTANCE FORM

INSTRUCTIONS: This form is to be completed by each employee to work on the subject project work site and returned to the Office Safety Coordinator (OSC) prior to site activities.

Project Name: _____

Project Number: _____

Date: _____

I represent that I have read and understand the contents of the above Plan and agree to perform my work in accordance with it.

_____
Signed

_____
Print Name

_____
Date

FORM 10

PLAN FEEDBACK FORM

Project Name: _____

Project Number: _____

Date: _____

Problems with plan requirements:

_____

_____

_____

_____

Unexpected situations encountered:

_____

_____

_____

_____

Recommendations for future revisions:

_____

_____

_____

_____

APPENDIX S-B

ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
°C	Degrees Celsius
CFR	Code of Federal Regulations
CGI	Combustible gas indicator
DHHS	Department of Health and Human Services
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
GC	Gas chromatography
GQAP	Generic Quality Assurance Plan
HSM	Health and Safety Manager
ID #	Identification Number
IDLH	Immediately Dangerous to Life and Health
LEL	Lower explosive limit
mg/m^3	Milligrams per cubic meter
mR	MilliRoentgen
NIOSH	National Institute of Occupational Safety and Health
OSC	Office Safety Coordinator
OSHA	Occupational Safety and Health Administration
PBK	Playback
PDS	Personnel Decontamination Station
PELs	Permissible Exposure Limits
PID	Photoionization detector
PPE	Personal Protective Equipment
ppm	Parts per million
QAP	Quality Assurance Plan
rpm	Revolutions per minute
SA	Shift-average
SSO	Site Safety Officer
TWA	Time-weighted-average

APPENDIX S-C

MATERIAL SAFETY DATA SHEETS (MSDSs)

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 674

ISOBUTYLENE

Issued: November 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: ISOBUTYLENE

Description (Origin/Uses): Obtained from refinery steams by absorption on 65% sulfuric acid (H_2SO_4) at 59°F (15°C). Used primarily to produce diisobutylene, trimers, butyl rubber, and other polymers; also used to produce antioxidants for foods, plastics, and packaging food supplements.

Other Designations: Isobutene; 2-Methylpropene; *gamma*-Butylene; $CH_2=C(CH_3)_2$; CAS No. 0115-11-7

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

NFPA

HMIS	
H 1	R 1
F 4	I 1
R 0	S 1
PPG*	K 4

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Isobutylene, CAS No. 0115-11-57	Ca 100	OSHA PEL None Established ACGIH TLV, 1988-89 None Established NIOSH REL None Established Toxicity Data* Rat, Inhalation, LC_{50}: 620 g/m³ (4 Hrs) Mouse, Inhalation, LC_{50}: 415 g/m³ (2 Hrs)

*Monitor NIOSH, *RTECS* (UD0890000), for additional data.

SECTION 3. PHYSICAL DATA

Boiling Point: -19.6°F (-6.9°C)
Melting Point: -220°F (-140°C)
Vapor Density (Air = 1): 1.9
Specific Gravity (H_2O = 1): Ca 0.6
Molecular Weight: 56 Grams/Mole
Solubility in Water (%): Insoluble*
% Volatile by Volume: 100

Appearance and Odor: A colorless, extremely flammable gas; odor not listed.

*Isobutylene is very soluble in alcohol, ether, and sulfuric acid.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature: 869°F (465°C)	LEL: 1.8% v/v	UEL: 9.6% v/v

Extinguishing Media: Isobutylene gas is an extremely flammable gas that has a substantial explosive air-gas range. For isobutylene fires, the recommended fire-fighting technique is to stop the flow of gas instead of extinguishing the fire. If the flames are extinguished and the isobutylene gas continues to escape or leak, an explosive air-gas mixture can form quickly and ignite without warning. A resulting explosion could cause greater damage than that which would be caused by allowing the fire to burn itself out. If the fire must be extinguished to allow safe access to shutoff valves, recommended extinguishing agents include CO_2 and dry chemical. **Unusual Fire or Explosion Hazards:** In many cases, the preferred strategy is to allow the flames to continue to burn and to cool the surroundings with water spray to prevent ignition of nearby combustibles. Isobutylene gas is heavier than air and can collect in low-lying, confined spaces. Potentially explosive air-gas mixtures are especially likely to build up in such an area, so enter it with extreme caution whether or not it is presently involved in a fire. Possible sources of ignition must not be brought into any area suspected of containing substantial concentrations of isobutylene gas. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

* Sax (Genium ref. 6) reports a flash point of -105°F (-76°C) for isobutylene.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Isobutylene is stable in closed, pressurized containers during routine operations at room temperature. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Isobutylene can react dangerously with strong oxidizing materials. **Conditions to Avoid:** Prevent exposing isobutylene to any source of ignition such as an open flame, sparks, lighted tobacco products, or steam lines. **Hazardous Products of Decomposition:** Isobutylene fires can produce toxic gases such as carbon monoxide (CO) or lower-molecular-weight hydrocarbons. **Comments:** The extreme flammability of isobutylene means that any reactions involving this material, including nonhazardous ones, must be performed carefully in order to prevent fires and/or explosions.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Isobutylene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Isobutylene is a simple asphyxiant. As such it will not cause significant physiological responses, but it can displace the minimum required atmospheric oxygen level. Significant displacement by isobutylene results in an oxygen-deficient atmosphere with no adequate warning properties. Asphyxiation fatalities can occur especially in confined, low-lying, poorly ventilated spaces because isobuty-

SECTION 6. HEALTH HAZARD INFORMATION, cont.

lene gas is almost twice as dense as air itself (see sect. 3). Medical Conditions Aggravated by Long-Term Exposure: None reported. Target Organs: None reported. Primary Entry: Inhalation. Acute Effects: Initial symptoms of the effects of simple asphyxiant gases are rapid respiration and air hunger, diminished mental alertness, and impaired muscular coordination. Continuing lack of oxygen causes faulty judgment, depression of all sensations, rapid fatigue, and emotional instability. As the asphyxia continues, nausea; vomiting; prostration; loss of consciousness; and, finally, convulsions; deep coma; and death can occur. Chronic Effects: None reported. FIRST AID: Inhalation. Would-be rescuers need to be concerned about their own safety when entering confined, poorly ventilated, oxygen-deficient areas. Self-contained breathing equipment must be readily available for rescuers. Station standby workers outside the immediate area so that they can summon additional help if it is needed. Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Comments: The extreme flammability of isobutylene gas warrants special attention even during rescue operations. Rescue personnel must not smoke. All emergency lamps and floodlights that must be lowered into enclosed areas for rescue operations must be explosion proof. Obtain this equipment before any emergency occurs and make it accessible to emergency-response personnel. Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: *Treat any isobutylene gas leak as an emergency.* If the leaking gas has not yet ignited, use water spray to direct flammable gas-air mixtures away from sources of ignition. Extinguish all sources of ignition as quickly as possible; however, if the leaking gas is burning, do not attempt to extinguish the flames until the source of the isobutylene gas is located and sealed. Otherwise, flammable isobutylene gas-air mixtures can explode without warning and cause widespread damage that might not have occurred if the original fire had been allowed to burn itself out. If it is necessary to extinguish isobutylene flames in order to gain access to a shutoff valve, use dry chemical or carbon dioxide as extinguishing agents. Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z): Not Listed

EPA Designations (40 CFR 302.4): Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

Respirator: Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA. Warning: Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres, which lack warning properties; to work in them safely requires that an SCBA be worn. Ventilation: Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the lower explosive limit cited in section 4. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Comments: Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale isobutylene vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store isobutylene in closed, pressurized containers in a cool, dry, well-ventilated area away from sources of ignition, combustible materials, and strong oxidizers. Protect containers from physical damage. Engineering Controls: Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Electrically ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations to prevent static sparks. Comments: Isobutylene is an extremely explosive and flammable gas. It must not be exposed to any possible source of ignition in work or storage areas.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Liquefied Petroleum Gas
DOT Hazard Class: Flammable Gas
ID No. UN1055
DOT Label: Flammable Gas
DOT Packaging Requirements: 49 CFR 173.304, 314, 315
DOT Packaging Exceptions: 49 CFR 173.306

IMO Shipping Name: Isobutylene
IMO Hazard Class: 2.1
IMO Label: Flammable Gas

References: 1, 6, 84-94, 116, 117, 120, 122.

Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: W Silverman, MD

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

NO. 43

TRISODIUM PHOSPHATE DODECAHYDRATE

Date November 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: TRISODIUM PHOSPHATE DODECAHYDRATE

DESCRIPTION: Crystallizes from water as $Na_3PO_4.12H_2O$ and can exist as several hydrate forms, depending on processing, and as the anhydrous salt.

OTHER DESIGNATIONS: TSP, Trisodium Orthophosphate, Sodium Phosphate, Tribasic, Teriary Sodium Phosphate, GE Material D4K1, ASTM D538, CAS# 007 601 549

MANUFACTURER: Available from several suppliers, including FMC Corporation, Monsanto Co., Stauffer Chemical Co., and Olin Corp.

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Trisodium Phosphate (as $Na_3PO_4.12H_2O$)	>97	No TLV established* ($Na_3PO_4.12H_2O$) Rat, Oral LD_{50} 7400 mg/kg

*Under OSHA inert dust limits it can be assumed that airborne particulate, not otherwise controlled, is limited to a maximum of 5 mg/kg of respirable dust; however, this level may not be adequate to prevent irritation with this material.

SECTION III. PHYSICAL DATA

Boiling point ——— -11 H_2O at 100 C (decomposes)

Melting point, deg C — >73.3 (dec)

Solubility, g/100g H_2O:

at 0 C ——— 1.5

at 15 C ——— 28.3

at 70 C ——— 157

Specific gravity (20/4 C) ——— 1.62

pH of 1% water solution at 25 C - ca 12

Molecular weight ——— 380.1

Appearance & Odor: White or colorless crystalline solid (also as powder flake, granules, etc.). No odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None	None	None		

Extinguishing Media: Use that which is appropriate to the surrounding fire; this material is non-combustible.

In a fire situation at high temperature phosphates can emit highly toxic phosphorus oxide fumes. Firefighters should use self-contained breathing apparatus.

SECTION V. REACTIVITY DATA

This material is a stable alkaline solid at room temperature. It does not undergo hazardous polymerization.

It is incompatible with acidic materials.

SECTION VI. HEALTH HAZARD INFORMATION

TLV None established (See Sect II)

This alkaline material will cause irritation to the respiratory tract if inhaled as a dust or as a solution mist. Prolonged or repeated skin contact will irritate the skin. Eye contact will irritate and can damage the eyes (alkaline attack). This material is low in toxicity by ingestion, but its alkaline nature will irritate, injure the digestive tract. (Trisodium phosphate is used as a food additive; but it must be reduced in alkalinity before being taken into the body.)

FIRST AID:

Eye contact: Promptly flush with plenty of water for 15 minutes. Get medical help.

Skin contact: Wash well with soap and water; rinse well with water. If irritation persists, get medical help.

Inhalation: Remove to fresh air. Get medical help if irritation persists.

Ingestion: Give 1-2 glasses of water or milk to drink to dilute; then give fruit juice or diluted vinegar to drink. Do not induce vomiting! Immediately contact a physician.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

For large spills, notify safety personnel. Clean-up personnel should use protection against contact or inhalation of dust or mist. Scoop up spill for recovery or disposal and place in a container with a lid. Flush residues to the sewer with plenty of water.

DISPOSAL: Scrap material can be used for neutralizing acidic wastes, or it can be buried in an approved manner in an approved landfill. Small amounts can be flushed to the sewer if regulations permit., Follow Federal, State and local regulations for disposal.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general ventilation to the workplace; if dusting conditions occur, local exhaust ventilation will be needed and a NIOSH approved dust respirator may be required.

The use of rubber or plastic gloves and chemical safety glasses with side shields is recommended for handling this material. An apron may also be desirable to prevent contact with clothing, especially where solutions are involved.

Provide eyewash station near to the workplace where this material is used; a safety shower may also be needed where large amounts of solution are prepared or used.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store this material in tightly sealed containers in a clean, dry, ventilated area. Prevent physical damage to containers.

Avoid contact with the body and inhalation of dust.

Note that anhydrous trisodium phosphate and lower hydrates are more alkaline <u>on a weight basis</u> than $Na_3PO_4.12H_2O$.

DATA SOURCE(S) CODE: 1.2.4-7.12.15

[redacted]

APPROVALS: MIS, CRD	
Industrial Hygiene and Safety	
Corporate Medical Staff	

DATE: 04/19/91 ACCT: 192095-01
INDEX: 01911070364 CAT NO: A206C212 PO NBR: 02492-014-5355

NITRIC ACID
NITRIC ACID
NITRIC ACID

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

SUBSTANCE IDENTIFICATION

SUBSTANCE: **NITRIC ACID** CAS-NUMBER 7697-37-2

TRADE NAMES/SYNONYMS:
AQUA FORTIS; WFNA; RFNA; HYDROGEN NITRATE; AZOTIC ACID; NITRYL HYDROXIDE; NITAL; SICC 4918528; UN 2031; A200; A200C; A200S; A202; A206C; A509; A467; A200SI; A198C; A483; HNO3; ACC16550

CHEMICAL FAMILY:
INORGANIC ACID

MOLECULAR FORMULA: H-N-O3

MOLECULAR WEIGHT: 63.01

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: NITRIC ACID PERCENT: 70

COMPONENT: WATER PERCENT: 30

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NITRIC ACID:
2 PPM (5 MG/M3) OSHA TWA; 4 PPM (10 MG/M3) OSHA STEL
2 PPM (5 MG/M3) ACGIH TWA; 4 PPM (10 MG/M3) ACGIH STEL
2 PPM NIOSH RECOMMENDED 10 HOUR TWA

1000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
1000 POUNDS SARA SECTION 304 REPORTABLE QUANTITY
1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: COLORLESS TO PALE YELLOW LIQUID WITH A SUFFOCATING ODOR.

BOILING POINT: 181 F (83 C) MELTING POINT: -44 F (-42 C)

SPECIFIC GRAVITY: 1.5027 @ 25 C VAPOR PRESSURE: 47.9 MMHG @ 20 C

EVAPORATION RATE: NOT AVAILABLE SOLUBILITY IN WATER: VERY SOLUBLE

VAPOR DENSITY: 3.2

SOLVENT SOLUBILITY: SOLUBLE IN ETHER.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN OR OTHER GASES WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER. CONTACT WITH EASILY OXIDIZABLE, ORGANIC, OR OTHER COMBUSTIBLE MATERIALS MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

FIREFIGHTING MEDIA:

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WATER, DRY CHEMICAL OR SODA ASH
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, FLOOD AREA WITH WATER FROM A DISTANCE
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. FOR MASSIVE FIRE IN CARGO AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; IF THIS IS IMPOSSIBLE, WITHDRAW FROM AREA AND LET FIRE BURN (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 44).

USE FLOODING AMOUNTS OF WATER AS FOG. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS, KEEP UPWIND. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:
OXIDIZER

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND SUBPART E:
OXIDIZER AND CORROSIVE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.268
EXCEPTIONS: NONE

TOXICITY

NITRIC ACID;
TOXICITY DATA:
ANHYDROUS: 110 MG/KG UNREPORTED-MAN LDLO; 430 MG/KG ORAL-HUMAN LDLO; REPRODUCTIVE EFFECTS DATA (RTECS).
MONOHYDRATE: NO DATA AVAILABLE.
TRIHYDRATE: NO DATA AVAILABLE.
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYES, INGESTION.
ACUTE TOXICITY LEVEL: INSUFFICIENT DATA.
TARGET EFFECTS: NO DATA AVAILABLE.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH IMPAIRED PULMONARY FUNCTION, PRE-EXISTING EYE AND SKIN DISORDERS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NITRIC ACID;
CORROSIVE. 100 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INHALATION OF ACIDIC SUBSTANCES MAY CAUSE SEVERE RESPIRATORY IRRITATION WITH COUGHING, CHOKING, AND POSSIBLY YELLOWISH BURNS OF THE MUCOUS MEMBRANES. OTHER INITIAL SYMPTOMS MAY INCLUDE DIZZINESS, HEADACHE, NAUSEA, AND WEAKNESS. PULMONARY EDEMA MAY BE IMMEDIATE IN THE MOST SEVERE EXPOSURES, BUT MORE LIKELY WILL OCCUR AFTER A LATENT PERIOD OF 5-72 HOURS. THE SYMPTOMS MAY INCLUDE TIGHTNESS IN THE CHEST, DYSPNEA, DIZZINESS, FROTHY SPUTUM, AND CYANOSIS. PHYSICAL FINDINGS MAY INCLUDE HYPOTENSION, WEAK, RAPID PULSE, MOIST RALES, AND HEMOCONCENTRATION. IN NON-FATAL CASES, COMPLETE RECOVERY MAY OCCUR WITHIN A FEW DAYS OR WEEKS OR, CONVALESCENCE MAY BE PROLONGED WITH FREQUENT RELAPSES AND CONTINUED DYSPNEA AND OTHER SIGNS AND SYMPTOMS OF PULMONARY INSUFFICIENCY. IN SEVERE EXPOSURES, DEATH DUE TO ANOXIA MAY OCCUR WITHIN A FEW HOURS AFTER ONSET OF THE SYMPTOMS OF PULMONARY EDEMA OR FOLLOWING A RELAPSE.
CHRONIC EXPOSURE- DEPENDING ON THE CONCENTRATION AND DURATION OF EXPOSURE, REPEATED OR PROLONGED EXPOSURE TO AN ACIDIC SUBSTANCE MAY CAUSE EROSION OF THE TEETH, INFLAMMATORY AND ULCERATIVE CHANGES IN THE MOUTH, AND POSSIBLY JAW NECROSIS. BRONCHIAL IRRITATION WITH COUGH AND FREQUENT ATTACKS OF BRONCHIAL PNEUMONIA MAY OCCUR. GASTROINTESTINAL DISTURBANCES ARE ALSO POSSIBLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HA[illegible]ED, [illegible] ARTI[illegible] RES[illegible]ON. [illegible] IN A [illegible] AND PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT;
NITRIC ACID;
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID OR VAPOR MAY CAUSE SEVERE PAIN, BURNS AND POSSIBLY YELLOWISH STAINS. BURNS MAY BE DEEP WITH SHARP EDGES AND HEAL SLOWLY WITH SCAR TISSUE FORMATION. DILUTE SOLUTIONS OF NITRIC ACID MAY PRODUCE MILD IRRITATION AND HARDEN THE EPIDERMIS WITHOUT DESTROYING IT.

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CHRONIC EXPOSURE- EFFECTS DEPEND ON THE CONCENTRATION AND DURATION OF EXPOSURE. REPEATED OR PROLONGED CONTACT WITH ACIDIC SUBSTANCES MAY RESULT IN DERMATITIS OR EFFECTS SIMILAR TO ACUTE EXPOSURE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
NITRIC ACID:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT WITH ACIDIC SUBSTANCES MAY CAUSE PAIN AND LACRIMATION, PHOTOPHOBIA, AND BURNS, POSSIBLY SEVERE. THE DEGREE OF INJURY DEPENDS ON THE CONCENTRATION AND DURATION OF CONTACT. IN MILD BURNS, THE EPITHELIUM REGENERATES RAPIDLY AND THE EYE RECOVERS COMPLETELY. IN SEVERE CASES, THE EXTENT OF INJURY MAY NOT BE FULLY APPARENT FOR SEVERAL WEEKS. ULTIMATELY, THE WHOLE CORNEA MAY BECOME DEEPLY VASCULARIZED AND OPAQUE RESULTING IN BLINDNESS. IN THE WORST CASES, THE EYE MAY BE TOTALLY DESTROYED. CONCENTRATED NITRIC ACID MAY IMPART A YELLOW COLOR TO THE EYE UPON CONTACT.
CHRONIC EXPOSURE- EFFECTS DEPEND ON THE CONCENTRATION AND DURATION OF EXPOSURE. REPEATED OR PROLONGED EXPOSURE TO ACIDIC SUBSTANCES MAY CAUSE CONJUNCTIVITIS OR EFFECTS AS IN ACUTE EXPOSURE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NITRIC ACID:
CORROSIVE.
ACUTE EXPOSURE- ACIDIC SUBSTANCES MAY CAUSE CIRCUMORAL BURNS WITH YELLOW DISCOLORATION AND CORROSION OF THE MUCOUS MEMBRANES OF THE MOUTH, THROAT AND ESOPHAGUS. THERE MAY BE IMMEDIATE PAIN AND DIFFICULTY OR INABILITY TO SWALLOW OR SPEAK. EPIGLOTTAL EDEMA MAY RESULT IN RESPIRATORY DISTRESS AND POSSIBLY ASPHYXIA. MARKED THIRST, EPIGASTRIC PAIN, NAUSEA, VOMITING AND DIARRHEA MAY OCCUR. DEPENDING ON THE DEGREE OF ESOPHAGEAL AND GASTRIC CORROSION, THE VOMITUS MAY CONTAIN FRESH OR DARK PRECIPITATED BLOOD AND LARGE SHREDS OF MUCOSA. SHOCK WITH MARKED HYPOTENSION, WEAK, RAPID PULSE, SHALLOW RESPIRATION, AND CLAMMY SKIN MAY OCCUR. CIRCULATORY COLLAPSE MAY ENSUE AND IF UNCORRECTED, LEAD TO RENAL FAILURE. IN SEVERE CASES, GASTRIC, AND TO A LESSER DEGREE, ESOPHAGEAL PERFORATION AND SUBSEQUENT PERITONITIS MAY OCCUR AND BE ACCOMPANIED BY FEVER AND ABDOMINAL RIGIDITY. ESOPHAGEAL, GASTRIC AND PYLORIC STRICTURE MAY OCCUR WITHIN A FEW WEEKS, BUT MAY BE DELAYED FOR MONTHS OR EVEN YEARS. DEATH MAY RESULT WITHIN A SHORT TIME FROM ASPHYXIA, CIRCULATORY COLLAPSE OR ASPIRATION OF EVEN MINUTE AMOUNTS. LATER DEATH MAY BE DUE TO PERITONITIS, SEVERE NEPHRITIS OR PNEUMONIA. COMA AND CONVULSIONS SOMETIMES OCCUR TERMINALLY.
CHRONIC EXPOSURE- DEPENDING ON THE CONCENTRATION, REPEATED INGESTION OF ACIDIC SUBSTANCES MAY RESULT IN INFLAMMATORY AND ULCERATIVE CHANGES IN THE MUCOUS MEMBRANES OF THE MOUTH AND OTHER EFFECTS AS IN ACUTE INGESTION. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- DO NOT USE GASTRIC LAVAGE OR EMESIS. DILUTE THE ACID IMMEDIATELY BY DRINKING LARGE QUANTITIES OF WATER OR MILK. IF VOMITING PERSISTS, ADMINISTER FLUIDS REPEATEDLY. INGESTED ACID MUST BE DILUTED APPROXIMATELY 100 FOLD TO RENDER IT HARMLESS TO TISSUES. MAINTAIN AIRWAY AND TREAT SHOCK (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
REACTS EXOTHERMICALLY WITH WATER.

INCOMPATIBILITIES:

NITRIC ACID:
ACETIC ACID: MAY REACT EXPLOSIVELY.
ACETIC ANHYDRIDE: EXPLOSIVE REACTION BY FRICTION OR IMPACT.
ACETONE: MAY REACT EXPLOSIVELY.
ACETONITRILE: EXPLOSIVE MIXTURE.
4-ACETOXY-3-METHOXYBENZALDEHYDE: EXOTHERMIC REACTION.
ACROLEIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ACRYLONITRILE: EXPLOSIVE REACTION AT 90 C.
ACRYLONITRILE-METHACRYLATE COPOLYMER: INCOMPATIBLE.
ALCOHOLS: POSSIBLE VIOLENT REACTION OR EXPLOSION; FORMATION OF EXPLOSIVE COMPOUND IN THE PRESENCE OF HEAVY METALS.
ALKANETHIOLS: EXOTHERMIC REACTION WITH POSSIBLE IGNITION.
2-ALKOXY-1,3-DITHIA-2-PHOSPHOLANE: IGNITION REACTION.
ALLYL ALCOHOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ALLYL CHLORIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

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AMINES (ALIPHATIC OR AROMATIC): POSSIBLE IGNITION REACTION.
2-AMINOETHANOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
2-AMINOTHIAZOLE: EXPLOSIVE REACTION.
AMMONIA (GAS): BURNS IN AN ATMOSPHERE OF NITRIC ACID VAPOR.
AMMONIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
AMMONIUM NITRATE: FORMS EXPLOSIVE MIXTURE.
ANILINE: IGNITES ON CONTACT.
ANILINIUM NITRATE: FORMS EXPLOSIVE SOLUTION.
ANION EXCHANGE RESINS: POSSIBLE VIOLENT EXOTHERMIC REACTION.
ANTIMONY: VIOLENT REACTION.
ARSINE: EXPLOSIVE REACTION.
ARSINE-BORON TRIBROMIDE: VIOLENT OXIDATION.
BASES: REACTS.
BENZENE: EXPLOSIVE REACTION.
BENZIDINE: SPONTANEOUS IGNITION.
BENZONITRILE: POSSIBLE EXPLOSION.
BENZOTHIOPHENE DERIVATIVES: FORMATION OF POSSIBLY EXPLOSIVE COMPOUNDS.
N-BENZYL-N-ETHYLANILINE: VIGOROUS DECOMPOSITION.
1,4-BIS(METHOXYMETHYL)2,3,5,6-TETRAMETHYLBENZENE: GAS EVOLUTION.
BISMUTH: INTENSE EXOTHERMIC REACTION OR EXPLOSION.
1,3-BIS(TRIFLUOROMETHYL)BENZENE: POSSIBLE EXPLOSION.
BORON: VIOLENT REACTION WITH INCANDESCENCE.
BORON DECAHYDRIDE: EXPLOSIVE REACTION.
BORON PHOSPHIDE: IGNITION REACTION.
BROMINE PENTAFLUORIDE: IGNITION REACTION.
N-BUTYL MERCAPTAN: IGNITION REACTION.
N-BUTYRALDEHYDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CADMIUM PHOSPHIDE: EXPLOSIVE REACTION.
CALCIUM HYPOPHOSPHITE: IGNITION REACTION.
CARBON (PULVERIZED): VIOLENT REACTION.
CELLULOSE: FORMS EASILY COMBUSTIBLE ESTER.
CHLORATES: REACTS.
CHLORINE: INCOMPATIBLE.
CHLORINE TRIFLUORIDE: VIOLENT REACTION.
CHLOROBENZENE: POSSIBLE EXPLOSION.
4-CHLORO-2-NITROANILINE: FORMS EXPLOSIVE COMPOUND.
CHLOROSULFONIC ACID: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
COAL: EXPLOSIVE MIXTURE.
COATINGS: MAY BE ATTACKED.
CRESOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CROTONALDEHYDE: VIOLENT DECOMPOSITION WITH IGNITION.
CUMENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CUPRIC NITRIDE: EXPLOSIVE REACTION.
CUPROUS NITRIDE: VIOLENT REACTION.
CYANATES: POSSIBLE EXPLOSIVE REACTION.
CYCLOHEXANONE: VIOLENT REACTION.
CYCLOHEXYLAMINE: FORMS EXPLOSIVE COMPOUND.
CYCLOPENTADIENE: EXPLOSIVE REACTION.
1,2-DIAMINOETHANEBIS(TRIMETHYLGOLD): EXPLOSIVE REACTION.
DIBORANE: SPONTANEOUS IGNITION.
DI-2-BUTOXYETHYL ETHER: VIOLENT DECOMPOSITION REACTION.
2,6-DI-T-BUTYL PHENOL: FORMATION OF EXPLOSIVE COMPOUND.
DICHLOROETHANE: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
DICHLOROETHYLENE: FORMS EXPLOSIVE COMPOUND.
DICHLOROMETHANE: FORMS EXPLOSIVE SOLUTION.
DICYCLOPENTADIENE: SPONTANEOUS IGNITION.
DIENES: IGNITION REACTION.
DIETHYLAMINO ETHANOL: POSSIBLE EXPLOSION.
DIETHYL ETHER: POSSIBLE EXPLOSION.
3,6-DIHYDRO-1,2,2H-OXAZINE: EXPLOSIVE INTERACTION.
DIISOPROPYL ETHER: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
DIMETHYLAMINOMETHYLFERROCENE: VIOLENT DECOMPOSITION IF HEATED.
DIMETHYL ETHER: FORMS EXPLOSIVE COMPOUND.
DIMETHYL HYDRAZINE: IGNITES ON CONTACT.
DIMETHYL SULFOXIDE + 1,4-DIOXANE: EXPLOSION.
DIMETHYL SULFOXIDE + <14% WATER: EXPLOSIVE REACTION.
DINITROBENZENE: EXPLOSION HAZARD.
DINITROTOLUENE: EXPLOSIVE REACTION.
DIOXANE + PERCHLORIC ACID: POSSIBLE EXPLOSION.
DIPHENYL DISTIBENE: EXPLOSIVE OXIDATION.
DIPHENYL MERCURY + CARBON DISULFIDE: VIOLENT REACTION.
DIPHENYL TIN: IGNITION REACTION.
DISODIUM PHENYL ORTHOPHOSPHATE: VIOLENT EXPLOSION.
DIVINYL ETHER: POSSIBLE IGNITION REACTION.
EPICHLOROHYDRIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

ULF ERE
ETH IHI HATE TIO NTA
M-ETHYL ANILINE: IGNITION REACTION.
ETHYLENE DIAMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ETHYLENE GLYCOL: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
ETHYLENEIMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
5-ETHYL-2-METHYL PYRIDINE: EXPLOSIVE REACTION.
ETHYL PHOSPHINE: IGNITION REACTION.
5 ETHYL-2-PICOLINE: FORMS EXPLOSIVE COMPOUNDS.
FERROUS OXIDE (POWDERED): INTENSE EXOTHERMIC REACTION.
FLUORINE: POSSIBLE EXPLOSIVE REACTION.
FORMIC ACID: EXOTHERMIC REACTION WITH RELEASE OF TOXIC GASES.
2-FORMYLAMINO-1-PHENYL-1,3-PROPANEDIOL: POSSIBLE EXPLOSION.
FUEL OIL (BURNING): EXPLOSION.
FULMINATES: REACTS.

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FURFURYLIDENE KETONES: IGNITES ON CONTACT.
GERMANIUM: VIOLENT REACTION.
GLYCEROL: POSSIBLE EXPLOSION.
GLYOXAL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
HEXALITHIUM DISILICIDE: EXPLOSIVE REACTION.
HEXAMETHYLBENZENE: POSSIBLE EXPLOSION.
2,2,4,4,6,6-HEXAMETHYLTRITHIANE: EXPLOSIVE OXIDATION.
HEXENAL: EXPLODES ON HEATING.
HYDRAZINE: VIOLENT REACTION.
HYDRAZOIC ACID: EMERGETIC REACTION.
HYDROGEN IODIDE: IGNITION REACTION.
HYDROGEN PEROXIDE: FORMS UNSTABLE MIXTURE.
HYDROGEN PEROXIDE AND KETONES: FORMS EXPLOSIVE PRODUCTS.
HYDROGEN PEROXIDE AND MERCURIC OXIDE: FORMS EXPLOSIVE COMPOUNDS.
HYDROGEN PEROXIDE AND THIOUREA: FORMS EXPLOSIVE COMPOUNDS.
HYDROGEN SELENIDE: IGNITION REACTION.
HYDROGEN SULFIDE: INCANDESCENT REACTION.
HYDROGEN TELLURIDE: IGNITION AND POSSIBLE EXPLOSIVE REACTION.
INDANE AND SULFURIC ACID: EXPLOSIVE REACTION.
ISOPRENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
KETONES (CYCLIC): VIOLENT REACTION.
LACTIC ACID + HYDROFLUORIC ACID: EXPLOSIVE REACTION.
LITHIUM: IGNITION REACTION.
LITHIUM SILICIDE: INCANDESCENT REACTION.
MAGNESIUM: EXPLOSIVE REACTION.
MAGNESIUM + 2-NITROANILINE: MAY IGNITE ON CONTACT.
MAGNESIUM PHOSPHIDE: INCANDESCENT REACTION.
MAGNESIUM SILICIDE: VIOLENT REACTION.
MAGNESIUM-TITANIUM ALLOY: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
MANGANESE (POWDERED): INCANDESCENCE AND POSSIBLE EXPLOSION.
MESITYL OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
MESITYLENE: POSSIBLE EXPLOSIVE REACTION.
METALS: VIOLENT REACTION WITH EXPLOSION OR IGNITION.
METAL ACETYLIDES: VIOLENT OR EXPLOSIVE REACTION.
METAL CARBIDES: VIOLENT OR EXPLOSIVE REACTION.
METAL CYANIDES: EXPLOSIVE REACTIONS.
METAL FERRICYANIDE OR FERROCYANIDE: VIOLENT REACTION.
METAL SALICYLATES: FORMS EXPLOSIVE COMPOUNDS.
METAL THIOCYANATES: POSSIBLE EXPLOSION.
2-METHYLBENZIMIDAZOLE + SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
4-METHYLCYCLOHEXANONE: EXPLOSIVE REACTION.
2-METHYL-5-ETHYLPYRIDINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
METHYL THIOPHENE: IGNITION REACTION.
NEODYMIUM PHOSPHIDE: VIOLENT REACTION.
NICKEL TETRAPHOSPHIDE: IGNITION REACTION.
NITRO AROMATIC HYDROCARBONS: FORMS HIGHLY EXPLOSIVE PRODUCTS.
NITROBENZENE: EXPLOSIVE REACTION, ESPECIALLY IN THE PRESENCE OF WATER.
NITROMETHANE: EXPLOSIVE REACTION.
NITRONAPHTHALENE: EXPLOSION HAZARD.
NON-METAL OXIDES : EXPLOSIVE REACTION.
OLEUM: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ORGANIC MATERIALS: FIRE AND EXPLOSION HAZARD.
ORGANIC SUBSTANCES AND PERCHLORATES: POSSIBLE EXPLOSION.
ORGANIC SUBSTANCES AND SULFURIC ACID: POSSIBLE EXPLOSION.
PHENYL ACETYLENE + 1,1-DIMETHYLHYDRAZINE: VIOLENT REACTION.
PHENYL ORTHOPHOSPHORIC ACID DISODIUM SALT: FORMS EXPLOSIVE PRODUCTS.
PHOSPHINE + OXYGEN: SPONTANEOUS IGNITION.
PHOSPHONIUM IODIDE: IGNITION REACTION.
PHOSPHORUS (VAPOR): IGNITES WHEN HEATED.
PHOSPHOROUS HALIDES: IGNITION REACTION.
PHOSPHORUS TETRAIODIDE: VIGOROUS REACTION.
PHOSPHORUS TRICHLORIDE: EXPLOSIVE REACTION.
PHTHALIC ACID AND SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
PHTHALIC ANHYDRIDE: EXOTHERMIC REACTION AND FORMS EXPLOSIVE PRODUCTS.
PICRATES: REACTS.
PLASTICS: MAY BE ATTACKED.
POLYALKENES: INTENSE REACTION..
POLYDIBROMOSILANES: EXPLOSIVE REACTION.
POLY(ETHYLENE OXIDE) DERIVATIVES: POSSIBLE EXPLOSION.
POLYPROPYLENE: TEMPERATURE AND PRESSURE INCREASE IN A CLOSED CONTAINER.
POLY(SILYLENE): IGNITION.
POLYURETHANE (FOAM): VIGOROUS REACTION.
POTASSIUM HYPOPHOSPHITE: EXPLOSIVE REACTION.
POTASSIUM PHOSPHINATE: EXPLODES ON EVAPORATION.
B-PROPIOLACTONE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PROPIOPHENONE + SULFURIC ACID: EXOTHERMIC REACTION ABOVE -5 C.
PROPYLENE GLYCOL + HYDROFLUORIC ACID + SILVER NITRATE: EXPLOSIVE MIXTURE.
PROPYLENE OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PYRIDINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PYROCATECHOL: IGNITES ON CONTACT.
REDUCING AGENTS: POSSIBLE EXPLOSIVE OR IGNITION REACTION.
RESORCINOL: POSSIBLE EXPLOSION.
RUBBER: VIGOROUS REACTION, POSSIBLE EXPLOSION.
SELENIUM: VIGOROUS REACTION.
SELENIUM HYDRIDE: IGNITION OR INCANDESCENT REACTION.
SELENIUM IODOPHOSPHIDE: EXPLOSIVE REACTION.
SILICON: VIOLENT REACTION.
SILICONE OIL: POSSIBLE EXPLOSION.
SILVER BUTEN-3-YNIDE: EXPLOSION.

SODIUM: SPONTANEOUS IGNITION.
SODIUM AZIDE: EXOTHERMIC REACTION.
SODIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN A CLOSED CONTAINER.
STIBINE: EXPLOSIVE REACTION.
SUCROSE (SOLID): VIGOROUS REACTION.
SULFAMIC ACID: VIOLENT REACTION WITH EVOLUTION OF TOXIC NITROUS OXIDE.
SULFIDES: REACTS.
SULFUR DIOXIDE: EXPLOSIVE REACTION.
SULFUR HALIDES: VIOLENT REACTION.
SULFURIC ACID + GLYCERIDES: EXPLOSIVE REACTION.
SULFURIC ACID + TEREPHTHALIC ACID: VIOLENT REACTION.
SURFACTANTS + PHOSPHORIC ACID: EXPLOSION HAZARD.
TERPENES: SPONTANEOUS IGNITION.
TETRABORANE: EXPLOSIVE REACTION.
TETRABORANE DECAHYDRIDE: EXPLOSIVE REACTION.
TETRAPHOSPHORUS DIIODOTRISELENIDE: EXPLOSIVE REACTION.
TETRAPHOSPHORUS IODIDE: IGNITES ON CONTACT.
TETRAPHOSPHORUS TETRAOXIDE TRISULFIDE: VIOLENT REACTION.
THIOALDEHYDES: VIOLENT REACTION.
THIOKETONES: VIOLENT REACTION.
THIOPHENES: EXPLOSIVE REACTION.
TITANIUM: FORMS SHOCK-SENSITIVE COMPOUND.
TITANIUM ALLOYS: POSSIBLE EXPLOSIVE REACTION.
TITANIUM-MAGNESIUM ALLOY: POSSIBLE EXPLOSION ON IMPACT.
TOLUENE: VIOLENT REACTION.
TOLUIDENE: IGNITION REACTION.
1,3,5-TRIACETYLHEXAHYDRO-1,3,5-TRIAZINE + TRIFLUOROACETIC ANHYDRIDE: EXPLOSIVE REACTION.
TRIAZINE: VIOLENTLY EXPLOSIVE REACTION.
TRICADMIUM DIPHOSPHIDE: EXPLOSIVE REACTION.
TRIETHYLGALLIUM MONOETHYL ETHER COMPLEX: IGNITION REACTION.
TRIMETHYLTRIOXANE: INTENSE REACTION.
TRIS(IODOMERCURI)PHOSPHINE: VIOLENT DECOMPOSITION.
TRITHIOACETONE: EXPLOSIVE REACTION.
TURPENTINE: EXPLOSIVE MIXTURE.
UNSYMMETRICAL DIMETHYL HYDRAZINE: SPONTANEOUS IGNITION.
URANIUM: EXPLOSIVE REACTION.
URANIUM ALLOY: VIOLENT REACTION.
URANIUM DISULFIDE: VIOLENT REACTION.
URANIUM-NEODYMIUM ALLOYS: EXPLOSIVE REACTION.
VINYL ACETATE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
VINYLIDENE CHLORIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
WOOD: POSSIBLE IGNITION.
P-XYLENE: INTENSE REACTION IN PRESENCE OF SULFURIC ACID.
ZINC: INCANDESCENT REACTION.
ZINC ETHOXIDE: POSSIBLE EXPLOSION.
ZIRCONIUM-URANIUM ALLOYS: EXPLOSIVE REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

PROTECT AGAINST PHYSICAL DAMAGE. SEPARATE FROM METALLIC POWDERS, CARBIDES, HYDROGEN SULFIDE, TURPENTINE, ORGANIC ACIDS, AND ALL COMBUSTIBLE, ORGANIC OR OTHER READILY OXIDIZABLE MATERIALS. PROVIDE GOOD VENTILATION AND AVOID DIRECT SUNLIGHT (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ FOR THAT SUBSTANCE MUST NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION THAT THE FACILITY IS PRESENT OR MAY BE AFFECTED IF A RELEASE OCCURS. EACH FACILITY WHERE SUCH A SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ FOR THAT SUBSTANCE MUST ALSO PARTICIPATE IN THE LOCAL EMERGENCY PLANNING PROCESS AS SPECIFIED IN THE EMERGENCY PLAN FOR THE COMMUNITY IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D002.
100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

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CONDITIONS TO AVOID

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MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTS VIOLENTLY WITH WATER AND FUELS. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG A HOLDING AREA SUCH AS A PIT, POND OR LAGOON TO CONTAIN SPILL AND DIKE SURFACE FLOW USING BARRIER OF SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB LIQUID MASS WITH FLY ASH OR CEMENT POWDER.

NEUTRALIZE SPILL WITH SLAKED LIME, SODIUM BICARBONATE OR CRUSHED LIMESTONE.

AIR SPILL:
APPLY WATER SPRAY TO KNOCK DOWN AND REDUCE VAPORS. KNOCK-DOWN WATER IS CORROSIVE AND TOXIC AND SHOULD BE DIKED FOR CONTAINMENT AND LATER DISPOSAL.

WATER SPILL:
ADD SUITABLE AGENT TO NEUTRALIZE SPILLED MATERIAL TO PH-7.

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. DO NOT GET WATER INSIDE CONTAINER. FOR SMALL SPILLS, FLUSH AREA WITH FLOODING AMOUNTS OF WATER. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

REPORTABLE QUANTITY (RQ): 1000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

NITRIC ACID:

125 MG/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.

250 MG/M3- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST NITRIC ACID.
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND CARTRIDGE(S) PROVIDING PROTECTION AGAINST NITRIC ACID.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT-OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST NITRIC ACID.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

NOTE: ONLY NON-OXIDIZABLE SORBENTS ARE ALLOWED (NOT CHARCOAL).

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ANY SUPPLIED AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

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GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC, INC.
CREATION DATE: 12/04/84 REVISION DATE: 12/14/90

-ADDITIONAL INFORMATION-

PART II
STANDARD PROCEDURES SECTION

DAMES & MOORE
HEALTH AND SAFETY PLAN

PART II
STANDARD PROCEDURES SECTION

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3.0 EMERGENCY INFORMATION

3.1 Emergency Response Plan

This section describes contingencies and emergency planning procedures to be implemented at the site. This Emergency Response Plan is compatible with local, state, and Federal disaster and emergency management plans, as appropriate. The list of appropriate emergency contacts is given in Part II of the HSP.

3.1.1 Pre-Emergency Planning

An emergency evacuation route(s) will be chosen immediately upon arrival at the site. During the periodic site briefings, all workers will be trained in provisions of the Emergency Response Plan, communication systems, and evacuation routes. The plan will be reviewed and revised, if necessary, on a regular basis by the OSC to ensure that the plan is adequate and consistent with prevailing site conditions.

3.1.2 Personnel Roles and Lines of Authority

The site supervisor has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public, such as evacuation of personnel and adjacent residents from the site area. The site supervisor must also ensure that corrective measures have been implemented, appropriate authorities have been notified, and follow-up reports have been completed. The OSC may be called upon to act on behalf of the site supervisor and will direct responses to any medical emergency.

The individual contractor organizations are responsible for assisting the Project Manager's mission within the parameters of their scope of work.

3.1.3 Emergency Recognition

Table S7-1, Exposure Limits and Recognition Qualities, and Table S7-2, Health Hazards and First Aid, provide listings of chemical and health hazards on site. For reference, a more comprehensive list of chemicals and health hazards are included in Appendices G-B and G-C. Personnel should be familiar with techniques of hazard recognition from pre-assignment training and site-specific briefings. The OSC should ensure that the proper prevention devices or equipment are available to personnel.

In an emergency, personnel should proceed to the closest exit with their buddies and go to the safe distance area associated with the evacuation route. Personnel should remain at that area until the re-entry alarm is sounded or further instructions are provided by an authorized individual.

3.1.4 Emergency Medical Treatment Procedures

Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing

in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. First aid kits will have gloves and artificial airways to protect against bloodborne pathogens, and personnel who have come into contact with bodily fluids such as blood or saliva will immediately confer with the Dames & Moore Medical Monitoring Program Manager to determine whether innoculation or other action is necessary. All injuries and illnesses must be reported immediately to the Project Manager.

Personnel who are transported to a clinic or hospital for treatment should take with them information on the chemical(s) they have been exposed to at the site. This information is included in Table S7-1, Exposure Limits and Recognition Qualities.

Any vehicle used to transport contaminated personnel will be treated and cleaned, as necessary.

3.1.5 Exposure to Bloodborne Pathogens

For purposes of this health and safety plan, personnel fall into the category of classification B in Dames & Moore's Bloodborne Pathogens Program, which are jobs where required tasks normally do not but could involve exposure to blood, bodily fluids, or tissues—for example, in the event first aid or CPR is required. If exposure to blood, bodily fluids, or tissues occurs, Universal Precautions such as the following will minimize the chance of contracting disease.

- Wash hands with soap and water as soon as possible after contact with blood, bodily fluids, or human tissue from an injured worker. When handwashing facilities are not readily available, antiseptic hand cleansers in conjunction with clean cloth/paper towels shall be used and hands should be washed with soap and water as soon afterwards as possible.

- Wear gloves when anticipating contact with blood, bodily fluid, tissues, mucous membranes, or contaminated surfaces, or if breaks in the skin are present.

- Wear appropriate protective equipment at all times, including a mask and eye protection, if aerosolization or splattering is likely to occur when attending to an injured worker or when conducting normal work routines.

- Insure that mouthpieces and appropriate personal protective equipment are readily available in first aid kits.

- Report immediately to the Site Safety Officer all sticks or cuts, mucosal splashes, or contamination of open wounds with blood or bodily fluids.

- Dispose of all spills which contain or may contain biological contaminants in accordance with policies for hazardous waste disposal. Until cleanup is complete, an accident area should be roped off from other workers.

The following work practice controls shall also be used to eliminate or minimize employee exposure. Where occupational exposure remains after instituting these controls, personal protective equipment shall also be used.

- Ingestion of bloodborne pathogens - Eating, drinking, smoking, applying cosmetics, and handling contact lenses are prohibited in work areas where there is a reasonable likelihood of occupational exposure. Food and drink shall not be kept in refrigerators, freezers, shelves, cabinets or on countertops or benchtops where blood or other potentially infectious materials are present.

- If handling potentially infectious bodily parts following dismemberment in an accident, specimens of blood or other potentially infectious materials shall be placed in a container which prevents leakage during collection, handling, processing, storage, transport, or shipping. The container shall be labelled or color coded according to labeling requirements and closed prior to storage, transportation, or shipping. If outside contamination of the primary container occurs, the primary container shall be placed within a secondary container that is puncture-resistant in addition to the above characteristics.

- Equipment (such as drill rigs or equipment used in first aid response) which may become contaminated with blood or other potentially infectious materials shall be examined prior to servicing or shipping and decontaminated as necessary, unless the site supervisor determines that decontamination of such equipment is not feasible. A readily observable biohazard label shall be attached to the equipment stating which portions remain contaminated. The site supervisor shall insure that this information is conveyed to all affected employees, the servicing representative and/or manufacturer as appropriate, prior to handling, servicing or shipping so that appropriate precautions may be taken.

- Personal protective equipment - appropriate personal protective equipment will be provided, such as gloves and mouthpieces in the first aid kit.

- All emergency first aid kits will contain red biohazard bags to contain waste created in first aid/emergency situations.

    - Gloves will be worn at all times.

    - Containers will not be overfilled.

    - Containers will be tightly closed or sealed prior to transportation.

    - Pools of blood, bodily fluid, tissue, or spills from biohazard waste containers shall be cleaned up with sodium hypochlorite or Chlorox bleach, 1 part to 10 parts water.

Employees who have had an exposure incident will be referred for a confidential post-exposure evaluation and followup. This will be made available within a reasonable time and location, and performed by or under the supervision of a licensed physician or licensed healthcare professional.

When an exposure incident is reported, the Project Manger will complete Form 2, Bloodborne Pathogens Incident Evaluation Form, and will immediately refer the employee for a confidential medical evaluation and followup. This referral must be made within 24 hours.

The decontamination of the equipment used during a bloodborne pathogen exposure should include the following:

1. Clean spills from around equipment immediately.

2. Employees engaged in cleaning equipment shall use personal protective equipment that will insure that there is no contact of potentially contaminated material with skin or personal clothing.

3. Clean large equipment with a germicidal detergent or bleach (1 part to 10 parts water), avoiding splatter or dripping. If dripping is reasonably anticipated, use a drop cloth under the equipment being cleaned.

4. Wipe contamination from small, reusable equipment. Label the equipment with warning labels indicating which parts are contaminated before sending it to an appropriate location for reprocessing.

5. All cleaning materials and personal protective equipment shall be disposed of as infectious waste or properly prepared for transport to a laundry as potentially infectious laundry.

6. Wash hands after removal of personal protective equipment.

3.1.5 Fire or Explosion

In the event of a fire or explosion, the local fire department should be notified immediately. The Site Safety Coordinator or a designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials onsite.

If it is safe to do so, site personnel may:

- Use fire fighting equipment available onsite to control or extinguish the fire.

- Remove or isolate flammable or other hazardous materials that may contribute to the fire.

3.1.7 Spills or Leaks

Containers shall be inspected and their integrity assured prior to being moved. Operations on-site will be organized so as to minimize the amount of container movement. Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (absorbent pillows, etc.) will be stationed in the immediate area. The spill containment program must be sufficient to contain and isolate the entire volume of hazardous substances being transferred. Drums or containers that cannot be moved without failure shall be emptied into a sound container. Fire extinguishing equipment shall be on hand and ready to use if needed to control incipient fires.

In the event of a spill or a leak, site personnel will:

- Inform their supervisor immediately.
- Locate the source of the spillage and stop the flow if it can be done safely.
- Begin containment and recovery of the spilled materials.

3.2 Reporting of Accidents and Unsafe Conditions

If an accident occurs, the supervisor or the SSO and the injured person(s) are to complete Form 3, Accident/Exposure Report Form, for submittal to the PM and the OSC, who will forward a copy to the Regional H&S Manager and the firmwide H&S Director. The OSC should ensure that followup action is taken to correct the situation that caused the accident. Details of Dames & Moore's procedures for reporting accidents and unsafe conditions are described in the firmwide Health and Safety Manual, Procedure No.: HS 210 - 210.3.

4.0 SITE CONTROL

4.1 General

The purpose of site control is to minimize potential contamination of workers, protect the public from the site's hazards, and prevent vandalism. Site control is especially important in emergency situations. Several site control procedures will be implemented to reduce worker and public exposure to chemical, physical, biological, and safety hazards.

4.2 Site Work Zones

To prevent the accidental spread of hazardous substances from a contaminated area to a clean area, zones will be delineated on the site where various operations will occur. The site will be divided into a minimum of three zones, as follows:

- The Exclusion Zone—The area where contamination is either known or likely to be present or, because of activity, will potentially harm personnel. Entry into the Exclusion Zone requires the use of PPE.

- The Contamination Reduction Zone—The area where personnel and equipment are decontaminated. It is essentially a buffer zone between contaminated areas and clean areas. Activities to be conducted in this zone will require personal protection as defined in Section 6.0.

- The Support Zone—The area situated in clean areas where the chance to encounter hazardous materials or conditions is minimal; therefore, PPE is not required.

- No unauthorized individuals are permitted in the Exclusion Zone, and the SSO has the authority to deny any person access to the Exclusion Zone if, in their judgement, the person does not meet entry requirements.

4.3 Standard Safe Work Practices

4.3.1 General

The following general safe work practices apply:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in contaminated or potentially contaminated areas, or where there is a possibility for the transfer of contamination.

- Contact with potentially contaminated substances should be avoided. Puddles, pools, mud, etc., should not be walked through. Kneeling, leaning, or sitting on equipment or the ground should be avoided, whenever possible. Monitoring equipment should not be placed on a potentially contaminated surface, such as the ground.

- Spillage should be prevented, to the extent possible. In the event that spillage occurs, the liquid should be contained, if possible.

- Splashing of contaminated materials should be prevented.

- Field crew members should use all their senses to alert themselves to potentially dangerous situations (i.e., presence of strong, irritating, or nauseating odors).

- Field crew members should be familiar with the physical characteristics of investigations, including:

  - Wind direction in relation to the ground zero area
  - Accessibility to associates, equipment, and vehicles
  - Communications
  - Hot zones (areas of known or suspected contamination)
  - Site access
  - Nearest water sources
  - Routes and procedures to be used during emergencies.

- A minimum number of personnel and equipment should be in the contaminated area, but only to the extent consistent with workforce requirements of safe site operations.

- All wastes generated during Dames & Moore or subcontractor activities at the site must be disposed of as directed by the Project Manager.

- No one wearing contact lenses or having a beard will be permitted in the work area if Level C or higher protection is required.

4.3.2 Buddy System

Workers will conduct all site activities with a buddy who is able to:

- Provide his or her partner with assistance
- Observe his or her partner for signs of chemical or heat exposure
- Periodically check the integrity of his or her partner's protective clothing
- Notify the site supervisor if emergency help is needed.
- Prearrange hand signals or other emergency communication signals such as:
  - Hand gripping throat: out of air, can't breathe.
  - Gripping partner's wrist or placing both hands around waist: leave area immediately, no debate.
  - Hands on top of head: need assistance.
  - Thumbs up: okay, I'm alright, I understand.
  - Thumbs down: no, negative.
  - Arms waving upright: send backup support.

5.0 MONITORING

5.1 General

Monitoring will be performed for the hazards presented in Table S7-1, Exposure Limits and Recognition Qualities, to ensure proper selection of engineering controls, work practices, and PPE so that employees are not exposed to levels that exceed permissible exposure limits or published exposure levels for hazardous substances. Air monitoring will be performed to identify Immediately Dangerous to Life and Health (IDLH) conditions, exposure over permissible exposure limits or published exposure levels, or other dangerous conditions such as the presence of flammable atmospheres or oxygen-deficient environments. Periodic monitoring will be conducted in the event of an IDLH condition or flammable atmosphere or when there is an indication that exposure levels may have risen, such as:

- When work begins on a different portion of the site.
- When contaminants other than those previously identified are being handled.
- When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).
- When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., spill or lagoon).

5.2 Monitoring Requirements

Equipment necessary for site monitoring may consist of an oxygen (O_2) meter, a photoionization detector (PID), and a combustible gas indicator (CGI). The types of monitoring instruments specified by the hazard, as well as the action levels to upgrade personal protection, are shown on Table S7-3, Hazard Monitoring Methods, Action Levels, and Protective Measures. All ambient measurements taken to evaluate employee exposures must be taken in the individual's breathing zone except combustible gas readings, which must be taken at the point where the explosion hazard is thought to exist and must be fairly constant for at least 30 seconds.

5.2.1 Instrument Calibration

All applicable instruments will be calibrated daily and after use. Readings will be recorded on Form 4, Equipment Log Form, referenced in Section 15.0. Appropriate manufacturer's instructions for the calibration of each instrument should be attached to the Site-Specific Health and Safety Plan.

5.2.2 Background Readings

Before any field activities commence, the background levels of the site must be read and noted. Daily background readings must be conducted away from areas of potential contamination to obtain accurate results. Monitoring personnel must consider potential interferences such as engine exhaust.

5.2.3 Air Monitoring Frequency

All site readings along with the date, time, background level, weather conditions, wind direction and speed, and the location where the background level was recorded must be noted on Form 5, Air Monitoring Data Form, referenced in Section 15.0.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 General

PPE that will protect employees from the hazards and potential hazards likely to be encountered during site investigations will be selected and used. PPE selection will be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site. The level of protection provided will be increased when site conditions deem it necessary to reduce employee exposures to below permissible exposure limits and published exposure levels for hazardous substances.

6.2 Levels of Protection

All field activities will be initiated at the level specified in Part II of the HSP (generally Level D). If the action levels specified in Table S7-3, Hazard Monitoring Methods, Action Levels, and Protective Measures, are reached, an upgrade will be made, as described in Table G6-1, Protective Equipment for On-Site Activities.

6.3 Respiratory Protection

If air purifying respirators are required, full facepiece respirators, with combination organic vapor and high efficiency dust and mist cartridges, will be used. Respirators belong to, and are only used and maintained by, the individual to whom they have been issued. Each Dames & Moore and subcontractor employee who anticipates working on site must be trained, fit tested, and declared medically fit to wear respiratory equipment prior to participating in field activities.

6.4 Personal Protective Equipment Program

Details of Dames & Moore's PPE Program are described in the firmwide Health and Safety Manual, Procedure Nos.: HS 150 - 150.12 and HS 170 - 170.9.

7.0 DECONTAMINATION

7.1 Standard Procedures

1. A decontamination area should be located between the Hot Line (upwind boundary of the Exclusion Zone) and the Support Zone boundary.

2. A personnel decontamination station (PDS) should be established.

3. All personnel should proceed through the appropriate contamination reduction sequence upon leaving the contamination area.

4. All protective gear should be left on site during any lunch break following decontamination procedures.

5. Material Safety Data Sheets for chemicals used during decontamination procedures should be made available to those who are potentially exposed to these chemicals and should be attached to this health and safety plan. See also Section 12.0 "Hazard Communication".

6. See Section 3.5.4.5, Exposure to Bloodborne Pathogens, for decontamination involving body fluids.

7.2 Decontamination of Equipment

To the extent possible, measures should be taken to prevent contamination of sampling and monitoring equipment. Sampling devices may become contaminated; however, monitoring instruments, unless they are splashed, usually do not become contaminated. Once contaminated, it is difficult to clean instruments without damaging them. Any delicate instrument that cannot be decontaminated easily should have a bag taped and secured around it. Openings should be made in the bag for sample intake.

7.2.1 Sampling Devices

Sampling devices require special cleaning. Decontamination of all sampling equipment should be performed in accordance with approved quality assurance plans.

7.2.2 Tools

Wooden tools are difficult to decontaminate because they absorb chemicals. They should be kept on site and handled only by protected workers. After use in a contaminated area, wooden tools should be discarded. For decontaminating other tools, refer to quality assurance plans or consult a laboratory.

7.2.3 Respirators

Certain parts of contaminated respirators, such as the harness assembly and cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded.

Rubber components can be soaked in soap and water and scrubbed with a brush. Persons responsible for decontaminating respirators should be thoroughly trained in respirator maintenance.

7.2.4 Heavy Equipment

Buildozers, trucks, backhoes, bulking chambers, and other heavy equipment are difficult to decontaminate. Generally, they are washed with water under high pressure and/or accessible parts are scrubbed with detergent/water solution under pressure, if possible. In some cases, shovels, scoops, and lifts have been sand blasted or steamed. Particular care must be given to those components in direct contact with contaminants, such as tires and scoops.

7.2.5 Sanitizing of Personal Protective Equipment

Respirators, reusable protective clothing, and other personal articles not only must be decontaminated before being reused, but also must be sanitized. The inside of masks and clothing becomes soiled because of exhalation, body oils, and perspiration. The manufacturer's instructions should be followed to sanitize the respirator mask. If practical, protective clothing should be machine washed after a thorough decontamination; otherwise, it must be cleaned by hand.

7.2.6 Persistent Contamination

In some instances, clothing and equipment will become contaminated with substances that cannot be removed by normal decontamination procedures. A strong detergent (industrial grade) may be used to remove such contamination from equipment if it does not destroy or degrade the protective material. If persistent contamination is expected, disposable garments should be used. Testing for persistent contamination of protective clothing and appropriate decontamination must be done by qualified laboratory personnel.

7.2.7 Disposal of Contaminated Materials

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be secured in drums or other containers and labeled. Clothing not completely decontaminated on site should be secured in plastic bags before being removed from the site.

Contaminated wash and rinse solutions should be contained by using step-in-containers (e.g., child's wading pool) to hold spent solutions. Another containment method is to dig a trench about 4 inches deep and line it with plastic. In both cases, the spent solutions should be transferred to drums, which should be labeled and disposed of with other substances on site.

7.3 Minimal Decontamination

Less extensive procedures for decontamination can be subsequently established when disposable clothing and equipment are used, the type and degree of contamination become known, or the potential for transfer is judged to be minimal by the Site Safety Coordinator (SSC) in consultation with the Project Manager.

7.4 Closure of the Personnel Decontamination Station

All disposable clothing and plastic sheeting used during the operation should be double bagged, labeled, and either contained on site or removed to a client-approved disposal facility. Grossly contaminated protective clothing should be disposed of on site with the permission of the property owner. Cloth items should be bagged and removed from the site for final cleaning. All wash tubs, pails, containers, etc., should be thoroughly washed, rinsed, and dried prior to removal from the site.

7.5 Level C Decontamination

The maximum decontamination layout for Level C is shown conceptually in Figure G7-1, Maximum Decontamination Layout for Level C Protection, and sketched in Figure G7-2, Layout of Personnel Decontamination Station. A description is given below.

Maximum Measures for Level C Decontamination

Station 1:	Segregated Equipment Drop	1.	Deposit equipment used on site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in plastic-lined containers. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, a cool down station may be set up within this area.
Station 2:	Boot Cover and Glove Wash	2.	Scrub outer boot covers and gloves with decon solution or detergent and water.
Station 3:	Boot Cover and Glove Rinse	3.	Rinse off decon solution from Station 2 using as much water as necessary.
Station 4:	Tape Removal	4.	Remove tape around boots and gloves and deposit it in the plastic-lined container.
Station 5:	Boot Cover Removal	5.	Remove boot covers and deposit them in the plastic-lined container.
Station 6:	Outer Glove Removal	6.	Remove outer gloves and deposit them in the plastic-lined container.
Station 7:	Suit and Boot Wash	7.	Wash splash suit, gloves, and safety boots. Scrub with long-handled scrub brush and decon solution.

Station 8:	Suit, Boot, and Glove Rinse	8.	Rinse off decontamination solution using water. Repeat as many times as necessary.
Station 9:	Cartridge or Mask Change	9.	If worker leaves the Exclusion Zone to change cartridges (or mask), this will be the last step in the decon procedure. After worker's cartridges are exchanged, new outer gloves and boot covers donned, and joints taped, worker returns to duty.
Station 10:	Safety Boot Removal	10.	Remove safety boots and deposit them in the plastic-lined container.
Station 11.	Splash Suit Removal	11.	With assistance from the helper, remove splash suit. Deposit it in the plastic-lined container.
Station 12:	Inner Glove Wash	12.	Wash inner gloves with decon solution.
Station 13:	Inner Glove Rinse	13.	Rinse inner gloves with water.
Station 14:	Facepiece Removal	14.	Remove facepiece and deposit it in the plastic-lined container. Avoid touching face with fingers.
Station 15:	Inner Glove Removal	15.	Remove inner gloves and deposit them in the plastic-lined container.
Station 16:	Inner Clothing Removal	16.	Remove clothing soaked with perspiration and place it in the plastic-lined container. Do not wear inner clothing off site because there is a possibility that small amounts of contaminants might have been transferred in removing the fully encapsulating suit.
Station 17:	Field Wash	17.	Shower if highly toxic, skin corrosive, or skin absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.
Station 18:	Redress	18.	Put on clean clothes.

8.0 EMPLOYEE TRAINING ASSIGNMENTS

8.1 General

All employees working on site who are exposed to hazardous substances, health hazards, or safety hazards; their supervisors; and the management responsible for the site must receive training before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances or safety or health hazards. Employees will not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

8.2 Initial Training

General site workers engaged in hazardous substance removal or other activities that may expose workers to hazardous substances and health hazards will receive a minimum of 40 hours of off-site instruction, and a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor.

8.3 Management and Supervisor Training

On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations will receive 40 hours of initial training, 3 days of supervised field experience, and at least 8 additional hours of specialized supervisory training.

8.4 Refresher Training

Employees, managers, and supervisors will receive 8 hours of refresher training annually.

8.5 Additional Training Requirements

Dames & Moore requires employees engaged in field activities be certified in both first aid and cardiopulmonary resuscitation. Details of Dames & Moore's Health and Safety Training Program are described in the firmwide Health and Safety Manual, Procedure No.: HS 110 - 110.4.

The U.S. Department of Transportation (DOT) requires that employees who directly affect the safety of hazardous material transportation receive General Awareness/Familiarization, Function-Specific, Safety, and (where applicable) Driver training. Those who ship any DOT hazardous materials, such as calibration or decontamination chemicals or preservatives or samples that are DOT hazardous, must have this training.

9.0 MEDICAL SURVEILLANCE

9.1 General

The following employees who participate in field activities involving hazardous waste will be included in the Dames & Moore Medical Surveillance Program:

- All employees who may be exposed to hazardous substances or health hazards at or above the permissible exposure limits, without regard to the use of respirators, for 30 days or more per year.
- All employees who wear a respirator as required by CFR 1910.134.
- All employees who are injured because of overexposure from an incident involving hazardous substances or health hazards.

9.2 Frequency of Medical Exams

Medical examinations and consultations will be made available to the employees discussed above on the following schedules:

- Prior to assignment.
- At least once every 12 months, unless the physician believes a longer interval (not greater than biennially) is appropriate.
- As soon as possible upon notification that the employee has developed signs or symptoms indicating possible overexposure.

9.3 Medical Surveillance Program

Specific requirements of Dames & Moore's Medical Surveillance Program can be found in the firmwide Health and Safety Manual, Procedure No.: HS 120 - 120.3.

10.0 STANDARD OPERATING PROCEDURES

10.1 Organizational Structure and Responsibilities

Responsibility for health and safety passes from the Chief Executive Officer to the Chief Operating Officer to the General Manager for each Dames & Moore division. The Chief Operating Officer appoints the firm's Director of Health and Safety. The Division Health and Safety Manager (HSM) is appointed by the General Manager. Office Safety Coordinators for each geographic office are selected by the Managing Officer or Group Leaders with concurrence from the HSM.

The health and safety issue is a project management responsibility. Each Project Manager is fully accountable for carrying out assigned work for each project in compliance with the firmwide Health and Safety Program. A complete description of the organizational structure is provided in the firmwide Health and Safety Manual, Procedure No.: HS 100.1.

10.1.1 Dames & Moore Project Manager

The Project Manager (PM) shall direct on-site investigations and operational efforts but may delegate all or part of these duties to the Site Manager. The PM:

1. Provides adequate project information to the Office Safety Coordinator so that an appropriate site-specific health and safety plan (HSP) can be developed for the project, with sufficient lead time and budget for development of the project HSP.

2. Reviews and approves the HSP.

3. Obtains appropriate monitoring and protective equipment.

4. Monitors safety performance of personnel for compliance with the project HSP.

5. Requires correction of unsafe work practices or conditions.

10.1.2 Dames & Moore Site Safety Officer

The Dames & Moore Site Safety Officer's (SSO) duties may be carried out by the PM or other site manager. The SSO:

1. Assures that Dames & Moore on-site personnel have read and clearly understand the provisions of this plan prior to on-site activities, including the procedures for handling emergencies and the location and use of first aid equipment.

2. Assures that Dames & Moore personnel are aware of the potential hazards associated with site operations.

3. Assures that the personal protective equipment designated in this plan is available and used properly by all Dames & Moore on-site personnel.

4. Supervises the safety performance of all Dames & Moore personnel to ensure that the required work practices are employed.

5. Prepares accident/incident reports and other forms.

6. Oversees implementation of the project HSP and informs the PM and OSC of any additions or modifications that may be appropriate.

7. Checks with the OSC or his designee to see that assigned personnel have correct Fit for Duty medical authorization.

8. Determines that monitoring equipment is used properly and is calibrated in accordance with manufacturer's instructions or other standards, and that results are properly recorded and filed.

9. Provides on-going review of the protection level needs as project work is performed, and informs the office safety coordinator and PM of the need to upgrade downgrade protection levels.

10. Requires correction of unsafe or potentially unsafe working conditions, or stops work in emergencies until such conditions are corrected.

11. Obtains a copy of subcontractor HSP's.

10.1.3 Dames & Moore Site Personnel

Project personnel involved in on-site investigations and operations are responsible for:

1. Taking reasonable precautions to prevent injury to themselves and to their fellow employees.

2. Performing only those tasks that they believe they can do safely, and immediately reporting any accidents or unsafe conditions to the SSO or PM.

3. Implementing the procedures set forth in the HSP, and reporting any deviations from the procedures described in the plan to the SSO or PM for action.

4. Notifying the PM and SSO of any special medical problems (i.e. allergies) and insuring that on-site personnel are aware of any such problems.

10.1.4 Regional Health and Safety Manager

The Regional Health and Safety Manager (RHSM) shall:

1. Approves the HSP.

2. Periodically audit the operation to ensure compliance with this plan.

3. Provide health and safety support as requested by the SSO and the PM.

10.2 Heat Stress/Cold Stress

If site work is to be conducted during the winter, cold stress is a concern to the health and safety of personnel. With regard to the wearing of Tyvek suits, because such disposal clothing does not "breathe," perspiration does not evaporate and the suits can become wet. Wet clothes combined with cold temperatures can lead to hypothermia. If the air temperature is less than 40 degrees Fahrenheit (°F) and an employee perspires, the employee must change to dry clothes. Table G10-1, Signs and Symptoms of Cold Stress, describes the signs and symptoms of cold stress.

Wearing PPE also puts a worker at a considerable risk of developing heat stress. Table G10-2, Signs and Symptoms of Heat Stress, describes the signs and symptoms of heat stress. This can result in health effects ranging from heat fatigue to serious illness or death. Consequently, regular monitoring and other precautions are vital.

For workers wearing standard work clothes, recommendations for monitoring and work/rest schedules are those approved by ACGIH and NIOSH. Workers wearing semipermeable PPE or impermeable PPE should be monitored when the temperature in the work area is above 70°F. To monitor the worker, the following should be measured:

- Heart rate—The radial pulse should be counted during a 30-second period as early as possible in the rest period.
  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle should be shortened by one third and the rest period should be kept the same.
  - If the heart rate still exceeds 110 beats per minute at the next rest period, the following work cycle should be shortened by one third.
- Oral temperature—A clinical thermometer (3 minutes under the tongue) or similar device should be used to measure the oral temperature at the end of the work period (before drinking).
  - If the oral temperature exceeds 99.6°F (37.6 degrees Celsius (°C)), the next work cycle should be shortened by one third, without the rest period being changed.
  - If the oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, the following work cycle should be shortened by one third.
  - A worker should not be permitted to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).
- Body water loss, if possible—Weight should be measured on a scale accurate to +/- 0.25 pound at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing. The body water loss should not exceed 1.5 percent of total body weight loss in a workday.

Initially, the frequency of monitoring depends on ambient temperature (see Table G10-3, Suggested Frequencies of Physiological Monitoring for Fit and Acclimatized Workers). The length of the work cycle is determined by the frequency of physiological monitoring described above.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important, because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, the following steps should be taken:

- Work schedules should be adjusted.

- Shelter (air-conditioned, if possible) or shaded areas should be provided to protect personnel during rest periods.

- Workers' body fluids should be maintained at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat—i.e., 8 fluid ounces (0.23 liter) of water must be ingested for approximately every 8 ounces (0.23 kilogram) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, the worker should be encouraged to drink more. The following strategies may be useful:

  - Water temperature should be maintained at 50°F to 60°F (10° to 15.6°C).

  - Small disposable cups that hold about 4 ounces (0.1 liter) should be provided.

10.3 Drilling Safety

10.3.1 Basic Requirements

Employees will not proceed with work on, or in the proximity of, hazardous equipment until they have been properly trained and have received a safety briefing. If drilling is at a hazardous substance site, the site-specific safety plan must be reviewed on site and discussed in the safety briefing. A record of this briefing should be logged on Form 6, Site Safety Briefing Form.

Potential hazards (e.g., overhead or underground power lines, oil or gas lines in the immediate vicinity of the drill site) must be removed, avoided by relocating the drill site, or adequately barricaded to eliminate the hazard.

The use of unsafe or defective equipment is not permitted. Equipment must be inspected regularly and, if found to be defective, must be immediately removed from use and either repaired or replaced.

Employees will be familiar with the location of first-aid kits and fire extinguishers. Telephone numbers for emergency assistance must be prominently posted and kept current.

10.3.2 General Requirements at Drilling Operations

10.3.2.1 Housekeeping

Good housekeeping conditions should be observed in and around the work area. Suitable storage places should be provided for all materials and supplies. Pipe, drill rods, etc., must be securely stacked on solid, level sills.

Work surfaces, platforms, stairways, walkways, scaffolding, and accessways will be kept free of obstructions. All debris will be collected and stored in piles or containers for removal and disposal.

10.3.2.2 Salamander Heaters

Salamanders will be used only with approved fuels (e.g., do not use gasoline). Salamander heaters must not be refueled or moved until they have been extinguished and permitted to cool. Heaters will be equipped with exhaust stacks and will not be set on or placed near combustible material. They should be equipped with metal stands that will provide adequate stability and permit at least a 2-inch clearance under the unit.

Burning salamanders must be attended at all times, with suitable fire extinguishers available to each attendant. If tarpaulins or other flexible materials are used to form a heating enclosure, they must be fire resistant and installed to prevent contact with the heater. Worn salamanders that have developed holes or have been otherwise damaged will be replaced and removed from service.

10.3.2.3 Lighting

In addition to providing required or recommended illumination intensities of at least 5 foot-candles, consideration should be given to the selection and placement of lighting equipment. Proper lighting should provide minimum glare, eliminate harsh shadows, and provide adequate illumination to perform work efficiently and safely.

Light bulbs should be of the heavy duty, outdoor, nonshattering type.

All lighting circuits, including drop cords, should be grounded and have ground fault interrupters. Lighting circuits will be inspected periodically, and defective wiring or fixtures will be removed from service.

10.3.2.4 Flammable Liquids

All highly flammable liquids should be stored and handled only in approved containers. Portable containers must be the approved red safety containers equipped with flame arresters and self-closing lids.

Approved hand pumps will be used to dispense gasoline from barrels. Gasoline must not be used for degreasing or to start fires. Also, gasoline containers should be clearly labeled, and storage areas should be posted with "No Smoking" signs. Fire extinguishers should be installed in all areas that contain flammable liquids.

10.3.2.5 Public Safety

Work areas will be regulated so that the public will be protected from injury or accident. Adequate danger signs, barriers, etc., will be placed to effectively warn the public of hazards as well as to restrict access to dangerous areas.

10.3.3 Off-Road Movement of Drill Rigs

The following rules apply to the off-road movement of drill rigs:

- Before moving a drill rig, an inspection should be made of the route of travel for depressions, slumps, gullies, ruts, and similar obstacles.
- The brakes of a drill rig carrier should always be checked before traveling, particularly on rough, uneven, or hilly ground.
- All passengers should be discharged before a drill rig is moved on rough or hilly terrain.
- The front axle of 4 x 4 or 6 x 6 vehicles or carriers should be engaged when traveling off road on hilly terrain.
- Caution should be used when traveling on a hillside. The hillside capability of drill rigs should be evaluated conservatively, because the addition of drilling tools may raise the center of mass. When possible, travel should be made directly uphill or downhill.
- Obstacles such as small logs, small erosion channels, or ditches should be crossed squarely, not at an angle.
- When lateral or overhead clearance is close, someone on the ground should be used as a guide.
- After the drill rig has been moved to a new drilling site, all brakes or locks should be set. Wheels should be blocked on steep grades.
- The mast (derrick) of the drill rig should not be in the raised or partially raised position during off-road travel.
- Loads on the drill rig and supporting trucks should be tied down during transport.

10.3.4 Drilling Equipment

10.3.4.1 Skid-Mounted Units

Labels clearly indicating the function and direction of control levers should be posted on the lower unit controls of all drills.

An emergency safety power shutoff device should be installed within reach of the operator on all units. The device should be clearly labeled or otherwise made readily identifiable and checked daily to ensure that it is operable. The power unit should be operated only by authorized and qualified personnel.

Equipment will be shut down during manual lubrication and while repairs or adjustments are being made. Equipment such as internal combustion engines will not be refueled while running. Where practical, the gasoline tank should be positioned or shielded to avoid accidental spillage of fuel on the engine or exhaust manifold during refueling operations. Hazardous gears and moving parts also should be shielded to prevent accidental contact.

A dry chemical or carbon dioxide fire extinguisher, rated 5 pounds or larger, should be carried on the unit and removed to a position within 25 feet of the worksite during drilling operations. Extinguishers will be inspected and tagged at least once every 3 months.

Engine exhaust systems should be equipped with spark arresters when operated in areas where sparks constitute a fire hazard.

10.3.4.2 Overhead and Underground Utilities

Special precaution must be taken when using a drill rig on a site within the vicinity of electrical power lines and other utilities. Electricity can shock, burn, and cause death.

Overhead and underground utilities should be located, noted, and emphasized on all boring location plans and assignment sheets. When overhead electrical power lines exist at or near a drilling site, all wires should be considered dangerous.

A check should be made for sagging power lines before a site is entered. Power lines should not be lifted to gain entrance. The appropriate utility company should be contacted and a request should be made that it lift or raise and cut off power to the lines.

The area around the drill rig should be inspected before the drill rig mast (derrick) is raised at a site in the vicinity of power lines. The minimum distance from any point on the drill rig to the nearest power line should be determined when the mast is raised or is being raised. The mast should not be raised and the drill rig should not be operated if this distance is less than 20 feet, because hoist lines and overhead power lines can be moved toward each other by the wind.

The existence of underground utilities, such as electric power, gas, petroleum, telephone, sewer, and water lines, should always be suspected. These underground electric lines are as dangerous as overhead lines, so a utility locating service should always be contacted.

There are generally two types of utility locating services. One is a "free" service that is paid for by companies with underground pipes, lines, etc., to protect the public and to prevent costly repairs. However, these services have access only to drawings for primary pipes or lines, typically on public property or right-of-way easements, but not to drawings showing supply or feeder lines from a primary system to the interior of a property. Therefore, they are not required, and in fact hesitate, to locate interior lines. Sites can be cleared for drilling by such services, but without the drill operator's knowledge of the locations of underground feeder or supply lines.

A second type of locating service is provided by a paid subcontractor who physically sweeps or clears interior locations using locating equipment. Locating costs can be minimized by obtaining all available maps, drawings, and employee interview information before contracting with the locating company. This is especially important at large industrial plants or military bases, which can have an intricate network of underground utilities. It is important that every location be cleared, even those for hand-auger borings.

If a sign warning of underground utilities is located on a site boundary, it should not be assumed that underground utilities are located on or near the boundary or property line under the sign; they may be a considerable distance from the sign. The utility company should be contacted to check it out.

The owners of utility lines or the nearest underground utility location service should always be contacted before drilling is started. However, remember that some services provide information on utilities going to, but not within, a site. Metal detectors or other locating equipment may be necessary to determine the presence of shallow (surface) utilities on site. The utility personnel should mark or flag the location of the underground lines and determine what specific precautions must be taken to ensure safety.

10.3.4.3 Site Selection and Working Platforms

In preparing a worksite located on adverse topography, precautions must be taken against cave-ins, slides, and loose boulders. The drill platform should be stabilized by outriggers or adequate timbering.

Prior to drilling, adequate site clearing and leveling should be performed to accommodate the drill rig and supplies and to provide a safe working area. Drilling should not commence when tree limbs, unstable ground, or site obstructions result in unsafe tool-handling conditions.

Suitable storage locations should be provided that allow for the convenient handling of tools, materials, and supplies without danger that they could fall and injure anyone. Storing or transporting tools, materials, or supplies within or on the drilling mast (derrick) should be avoided. Pipes, drill rods, bits, casings, augers, and similar drilling tools should be securely stacked in an orderly manner on racks or sills.

Penetration hammers or other types of driving hammers should be placed at a safe location on the ground or secured when unattended on a platform. Work areas, platforms, walkways, scaffolding, and other accessways should be kept free of obstructions and substances such as ice, grease, or oil that could create a hazardous surface. All controls, control linkages, and warning and operation lights and lenses also should be kept free of ice, grease, or oil.

In the vicinity of power transmission or distribution lines, drills should be adequately grounded and set with at least a 15-foot clearance between any part of the drill or mast and the power lines.

Toilet facilities will be convenient to drill crews, or transportation will be readily available to nearby toilet facilities. Toilets will be either the chemical type or constructed over ground pits, which will be backfilled when abandoned. They should be fly tight and maintained in a sanitary condition.

Mud pits and drainage excavations should be safely sloped and located to provide minimum interference with work. Where necessary, suitable barricades, catwalks, etc., should be provided to reduce the possibility of personal injury. Ladders will be positioned in pits or excavations that are 5 or more feet deep. Such excavations should be periodically inspected to ensure safe operation and adequate maintenance.

Truck-mounted drills will be equipped with a "safetyline" or with clearly marked and conspicuously located emergency switches. The safetyline emergency stop consists of a taut wire that runs around the back of the machine and connects to a special switch that turns off the power unit when the line is contacted. When emergency switches are used in lieu of a safetyline, there should be a minimum of two switches—one located within easy reach of the operator, and one located within easy reach of workers at ground level near the drill or auger head.

Trucks should not be moved backward unless the driver has personally inspected the area behind the truck. In restricted or congested areas, or areas where workmen are located, the assistance of a "spotter" is mandatory. Also, trucks will be equipped with serviceable automatic backup alarms.

Before the mast is raised, personnel will be cleared from the immediate area—with the exception of the operator and a helper, when necessary. A check should be made to ensure safe clearance from energized power lines or equipment. Unsecured equipment must be removed from the mast, and cables, mud lines, and catline ropes must be adequately secured to the mast before raising. After it is raised, the mast must be secured to the rig in an upright position with steel pins.

Drill equipment will not be moved until a thorough inspection has been made to ensure that the mast, drill rods, tools, and other equipment are secured. A check will also be made of the steering mechanism, brakes, lights, load limits, and proper flagging and lighting of load extensions. Applicable traffic laws will be observed when moving drill equipment over public roads.

10.3.5 Surface Drilling Operations

Before the mast of a drill rig is raised and drilling is commenced, the drill rig must first be leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after the initial setup. The mast should only be lowered when the leveling jacks are down, and the leveling jack pads should not be raised until the mast is completely lowered. Before drilling operations start, the mast should be secured or locked, if required by the drill's manufacturer.

Before the power unit is started, all gears should be disengaged, the cable drum brake should be set, and no rope should be in contact with the cathead.

Before the mast is raised, a check should be made for overhead obstructions. Everyone (with the exception of the operator) should be cleared from the areas immediately to the rear and sides of the mast and informed that the mast is being raised. The drill rig should not be driven from hole to hole with the mast in the raised position.

The drill rig should only be operated from the position of the controls. The operator should shut down the drill engine before leaving the vicinity of the drill. "Horsing around" the vicinity of

the drill rig and tool and supply storage areas is strictly prohibited, even when the drill rig is shut down. Caution should be taken when mounting/dismounting the platform.

Drill operations should be terminated during an electrical storm.

The consumption of alcoholic beverages, depressants, stimulants, or any other chemical substance while on the job is strictly prohibited. All unattended boreholes must be adequately covered or protected to prevent people or animals from stepping or falling into the hole. When the drilling project has been completed, all open boreholes should be adequately covered, protected, or backfilled, according to local or state regulations.

A safety chain and cable arrangement should be used to prevent water swivel and mud line whip. All water swivels and hoisting plugs should be checked for possible frozen bearings and should be properly lubricated before use. A frozen bearing could cause mud line whip, which could injure the operator.

Only drill operators should brake or set the chucks to prevent engagement of the transmission prior to removal of the chuck wrench. Also, the chuck jaws should be periodically checked and replaced as necessary.

A string of drill rods should not be braked by the chuck jaws during lowering into the hole. A catline or hoisting cable and plug should be used for braking prior to tightening of the chuck. Failure to follow this procedure could result in steel slivers on the rods, possible hand injuries, and loss of the rods into the hole. Following braking, drill rods should be allowed to drain completely before removal from the working area.

Drill rods will not be lowered into the hole with a pipe wrench. Serious back and hand injuries may result if the rods are lowered by this method.

When using drilling fluids, a rubber or other suitable wiper should be used to remove the material from the drill rods when removing them from the drill hole. When drilling with air, the exhaust and cuttings should be directed away from workers with such devices as diverter heads, the use of which should be stipulated on drilling agreements, where appropriate.

Care must be exercised by the operator to avoid a sudden hoist release of the drill rod while the rod is being carried from the hole. The hoisting capacity and weight of the drill rod must be known to prevent collapse of the mast during drill string removal from the hole. The operating capacity of the mast and hoist also must be known and must not be exceeded.

When tool joints are broken on the ground or on a drilling platform, fingers should be positioned so they will not be caught between the wrench handle and the ground or the platform if the wrench slips or the joint suddenly lets go. Pipe wrench jaws should be checked periodically and replaced as they become worn.

10.3.6 Use of Augers

The use of mismatched auger sections should be avoided. Different brands and different weights should not be used in the same auger flight.

Because some pins lose their temper after very little use, causing the spring or clip section to fail, only tight-fitting pins designed for the auger should be used.

A daily inspection—to include a thorough check of the hydraulic hoses, connections, and valves—will be made before equipment is used. Deficiencies should be corrected or safe condition verified before the equipment is started.

A durable sign containing the following wording should be installed on all equipment in full view of the operator:

- All personnel must be clear before starting this machine
- Stop the auger to clean it
- Stop engine when repairing, lubricating, or refueling
- Do not wear loose-fitting clothing or gauntlet-type gloves.

The following general procedures should be used when advancing a boring with continuous flight or hollow stem augers:

- An auger boring should be started with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low revolutions per minute (rpm).

- A system of responsibility should be established for the series of activities required for auger drilling, such as connecting or disconnecting auger sections and inserting or removing the auger fork. The operator must be sure that the tool handler is well away from the auger column and that the auger fork has been removed before rotation is started.

- Only the manufacturer's recommended method of securing the auger to the power coupling should be used. The coupling or the auger should not be touched with the hands, a wrench, or any other tool during rotation.

- Tool hoists should be used to handle auger sections whenever possible. Hands or fingers should never be placed under the bottom of an auger section when the auger is being hoisted over the top of the auger section in the ground or other hard surface, such as the drill rig platform. Feet should never be allowed to get under the auger section that is being hoisted.

- Workers should stay clear of the auger and other rotating components of the drill rig. Workers should never reach behind or around a rotating auger for any reason.

- Hands or feet should never be used to remove cuttings from the auger.

- Augers should be cleaned only when the drill rig is in neutral and the augers have stopped rotating. A special paddle should be designed for cleaning auger flights; if available, pressurized water is recommended for jet cleaning.

10.3.7 Use of Handtools and Portable Power Tools

Handtools should be kept in good repair and used only for their designed purposes. Proper protective eyewear should be worn when using handtools and portable power tools. Unguarded sharp-edged or pointed tools will not be carried in employees' pockets.

The use of tools with mushroomed heads, split or defective handles, worn parts, or other defects will not be permitted. Tools that have become unsafe will be reconditioned before reissue or discarded.

Throwing or dropping of tools from one level to another will not be permitted; rather, containers and hand lines should be used for transporting tools from one level to another.

Nonsparking tools will be used in atmospheres where sources of ignition may cause fire or explosion.

Electric-powered shop and hand tools will be of the double-insulated, shock-proof type or be effectively grounded. Power tools should be operated only by designated employees who are familiar with their use.

Portable grinding tools will not be used without properly installed safety guards. Guards and tool rests should be maintained in proper adjustment. Grinding wheels should not be operated at speeds in excess of the manufacturer's safe ratings. Cracked or defective wheels will not be used.

Portable circular saws should be equipped with guards that automatically enclose the cutting edges. Cracked or defective blades will not be used. Also, power saws will not be left running when unattended.

Portable pneumatic tools should be inspected periodically to ensure good mechanical condition. Pneumatic impact tools will be operated with safety clips or retainers installed to prevent the tools from accidentally being discharged from the chuck. Airhoses should not be disconnected from equipment until the pressure has been shut off and exhausted from the line. Safety lashing will be provided at all hose and tool connections on air lines over 0.5 inch in diameter. Leaking or defective hoses should be replaced.

When not in use, tools will not be left on scaffolds, ladders, or overhead working spaces. Containers should be provided to hold tools and prevent them from falling.

10.3.8 Use of Ropes, Chains, and Accessories

The use of ropes and chains will be governed by the instructions on usage and safety limits as recommended by the manufacturer. Ropes and chains should be inspected before use, and their loading should not exceed the manufacturer's safety limits.

Hooks used in hoisting personnel or in hoisting loads over or in the immediate vicinity of workers should be made of forged steel and equipped with safety keepers. When shackles are used under these conditions, they should be of the locking type or the pin should be secured to prohibit turning.

Load-lifting accessories, such as sheaves, shackles, hooks, headache balls, etc., should be obtained from a reputable manufacturer. The use of job-fabricated lifting accessories is expressly prohibited. Load-lifting accessories that show excessive wear or have been bent, twisted, or otherwise damaged will be removed from service.

10.3.3.1 Slings

When in use, slings should be inspected daily for signs of overloading, excessive wear, or damage. Defective slings should be removed from service and repaired or replaced before reuse.

Proper storage should be provided for slings to prevent any damage that would impair their strength. They should be protected from sharp, rough, or square corners to prevent cutting or breaking of fibers, strands, or chain links.

10.3.3.2 Wire Rope

The safe performance of wire rope or cables can be ensured by rigid periodic inspection and by proper use and care.

The maximum allowable load for wire hoisting rope must not exceed the safe working load prescribed by the manufacturer or the ultimate strength of the rope divided by the safety factor. Commercial end-fastenings, clips, and zinc sockets must be properly applied to develop maximum strength. Wire rope should be removed from hoisting or load-carrying service when kinked or when any one of the following conditions is observed:

- The existence of 12 randomly distributed broken wires in one rope lay, or four broken wires in a single strand in one rope lay.
- Evidence of corrosion or heat damage.
- One broken wire, rust, or corrosion adjacent to a socket or end-fitting (this requires removal from service or resocketing).
- Distortion, stretching, elongation, or abnormal reduction in diameter.

Wire rope found to be defective for hoisting or load-carrying should be plainly marked as being unfit for such use.

Running lines of hoisting equipment located within 8 feet of the ground or working level will be guarded; or access to the operating area can be restricted.

Rope clips attached with U-bolts should have the U-bolts on the dead end of the rope. When a wedge-socket fastening is used, the dead or short end of the cable should be clipped to the live cable with a U-bolt or another approved fastener.

10.3.8.3 Fiber and Synthetic-Fiber Rope

In selecting fiber and synthetic-fiber ropes for load-carrying purposes, only the best quality rope should be used, with size and application in accordance with the manufacturer's recommendations. These ropes should be inspected frequently to ensure safe performance.

Proper care must be given to ropes to maintain good condition and high strength capacity. Fiber ropes should not be allowed to freeze after becoming wet, but should be cleaned carefully and dried in loose coils. Ropes should not be stored close to cement, lime, acids, or alkalies. Ropes that have been exposed to these materials should be removed from service.

10.3.8.4 Chains

Extreme care is necessary in the use and maintenance of all load-carrying chains. They should be inspected by a competent person after each installation and regularly thereafter. Chains must not be subjected to a load greater than their rated safe loading, which is determined from capacity tables issued by the chain manufacturer.

Splicing broken chains by inserting a bolt between two links with the heads of the bolt and the nut sustaining the load, or by passing one link through another and inserting a bolt or a nail to hold it, is prohibited.

10.3.8.5 Hoists

If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated on a daily basis to ensure that the swivel freely rotates under load. If a rod-slipping device is used to hoist drill rods, the drill rods should not be drilled or rotated through the slipping device. No more than 1 foot (0.3 meter) of the drill rod column should be hoisted above the top of the mast (derrick). A rod column with loose tool joints should not be hoisted while the rod column is being supported by a slipping device. If drill rods slip back into the borehole, an attempt should not be made to brake the fall of the rods with your hands.

Most sheaves on drill rigs are stationary, with a single-part line. The manufacturer of the drill rig should be consulted before the number of line parts is increased. Wire ropes must be properly matched with each sheave.

Tool handling hoists should only be used for vertical lifting of tools (except when angle hole drilling). Tool handling hoists should not be used to pull on objects away from the drill rig; however, drills may be moved by using the main hoist as the wire rope is spooled through proper sheaves, according to the manufacturer's recommendations.

When tools or similar loads cannot be raised with a hoist, the hoist line should be disconnected and the tools connected directly to the feed mechanism of the drill. Hydraulic leveling jacks should not be used for added pull to the hoist line or the feed mechanism of the drill.

When attempting to pull out a mired vehicle or drill rig carrier, only a winch on the front or rear of the vehicle or drill rig carrier should be used and workers should stay as far away as possible from the wire rope. Tool hoists should not be used to pull out a mired vehicle or a drill rig carrier. The following rules also apply:

- The shock loading of a wire rope can be minimized by smooth and steady application of loads.

- Wire rope should be protected from sharp corners or edges.

- Clutches and brakes of hoists should be periodically inspected and tested.

- Gloves should always be worn when handling wire ropes.

- Following the installation of a new wire rope, a light load should be lifted first to allow the wire rope to adjust.

- A load should never be hoisted over someone's head, body, or feet, or left suspended in the air when the hoist is unattended.

- Hands should be kept away from hoists, wire rope, hoisting hooks, sheaves, and pinch point when the slack is being taken up, and when the load is being hoisted. Hands should not be used to guide wire ropes on hoist drums.

10.4 Excavation

10.4.1 General Requirements

The following general requirements should be followed for excavation:

- Excavations shall be conducted in strict accordance with OSHA 29CFR 1926.650 Subpart P regulations, which cover open excavations and define excavation to include trenches.

- The regulations require protection of employees in excavations against cave-ins, except when the excavation is in stable rock, less than five feet deep, or deemed safe by a competent person.

- Workers must be protected from loose rock or soil and material or equipment that may fall into the excavation.

- Underground utility installations must be identified and located.

- Inspection of the site by a competent person is required daily, or following a natural or man-made event that may alter conditions. If there is evidence of possible cave-ins, protective system failure, hazardous atmospheres, or other hazardous conditions, employees at risk must be removed until corrective steps have been taken.

- Safe and accessible means of access and egress must be provided.

- Warning systems for mobile equipment are required, such as barricades, hand or mechanical signals, or stop logs.

- The regulations require testing for hazardous atmospheres and controls, including daily inspection by a competent person.

- Any of four options for sloping and benching systems may be implemented for stability of adjacent structures. These include:

  - A slope of 34 degrees or less in lieu of soil classification.
  - Maximum allowable slopes according to Appendices A and B of the OSHA standard.
  - Sloping or benching designs in accordance with stated criteria.
  - Excavations designed by a registered professional engineer.

- Any of four options may be implemented for support and shield systems. These include:

  - Designs for timber shoring in trenches in accordance with set criteria.
  - Designs using manufacturers' tabulated data in accordance with set criteria.
  - Designs using other tabulated data.
  - Other designs approved by a registered professional engineer.

- Excavation shall stop during inclement weather, such as high winds, heavy rainfall, lightning, etc.

- Table G10-4, A Guide to Selection of Protective Systems, contains guidance on selection of protective systems per the OSHA standard.

10.4.1.1 Preliminary Inspection

Prior to excavation, the site should be thoroughly inspected to determine conditions that require special safety measures. The location of underground utilities, such as sewer, telephone, gas, water, and electric lines, must be determined and plainly staked. Necessary arrangements must be made with the utility company or owner for the protection, removal, or relocation of the underground utilities. In such circumstances, excavation will be done in a manner that does not endanger the employees engaged in the work or the underground utility. Utilities left in place should be protected by barricading, shoring, suspension, or other measures, as necessary.

10.4.1.2 Protection of the Public

Necessary barricades, walkways, lighting, and posting should be provided for the protection of the public prior to the start of excavation. Excavation operations on or near state, county, or city streets, accessways, or other locations where there is extensive interface with the public and/or motorized equipment will not start until all of the following actions have been taken:

- The contractor has contacted the authority having jurisdiction and obtained written permission to proceed with protective measures required.

- The contractor, using the authority's instructions and these standards, has developed an extensive and detailed standard operating plan.

- The plan has been discussed with affected employees, and applicable protective measures are in place and functioning.

10.4.1.3 Access and Lighting

Safe access will be provided for employees, including installation of walkways, stairs, ladders, etc. When operations are conducted during hours of darkness, adequate lighting will be provided at the excavation, borrow pits, and waste areas.

Where employees are required to enter excavations over 4 feet in depth, stairs, ladders, or ramps must be provided, so as to require no more than 25 feet of lateral travel. When access to excavations exceeds 20 feet vertically, ramps, stairs, or personnel hoists should be provided. Ladders extending from the bottom of the trench to at least 3 feet above the top must be placed within 25 feet of workers in the trench.

10.4.1.4 Personal Protective Equipment

PPE will be provided and used in accordance with the specific requirements set forth in the plan. Drillers and helpers must wear approved safety goggles or safety glasses with side shields, hearing protection, hard hats, and safety shoes.

10.4.1.5 Removal of Trees and Brush

Prior to excavation, trees, brush, boulders, and other surface obstacles that present a hazard to employees should be removed.

10.4.1.6 Slide Prevention and Trenching Requirements

All trench excavations over 5 feet in depth must be sloped to the angle of repose from the bottom of the trench, but never less than 3/4 horizontal to 1 vertical (i.e., 37 degrees from vertical), or supported by structures designed by a professional engineer. Excavations should be inspected following rainstorms or other hazardous events. Additional protection against possible slides or cave-ins shall be provided, as necessary.

10.4.1.7 Angle of Repose

The determination of the angle of repose and design of supporting systems should be based on a thorough evaluation of all pertinent factors, including depth of cut; possible variation in water content of the material; anticipated changes in the material from exposure to air, sun, water, or freezing; loading imposed by structures, equipment, or overlying or stored material; and vibrations from sources such as traffic, equipment, and blasting. The angle of repose for all excavations, including trenching, should be determined by a professional engineer, but in no event should the slope be less than 3/4 horizontal to 1 vertical (i.e., 37 degrees from vertical) from the bottom of the excavation.

10.4.1.8 Support Systems

Materials used for support systems, such as sheeting, piling, cribbing, bracing, shoring, and underpinning, should be in good serviceable condition, and timbers should be sound and free of large or loose knots. The design of support systems should be based on calculations of the forces and their directions, with consideration for surcharges, the angle of internal friction of materials, and other pertinent characteristics of the material to be retained.

When tight sheeting or sheet piling is used, full loading due to the ground water table should be assumed unless relieved by weep holes, drains, or other means. Cross braces and trench jacks should be placed in true horizontal position and secured to prevent sliding, falling, or kickouts. Additional stringers, ties, and bracing should be provided to allow for any necessary temporary removal of individual supports. Support systems should be planned and designed by a professional engineer competent in the field.

Backfilling and removal of trench support systems should progress together from the bottom of the trench. Jacks or braces should be released slowly. In unstable soil, ropes or other safe means will be used to remove the braces from the surface after workers have left the trench.

Special precaution must be taken in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or fill area. The use of compacted backfill as backforms on slopes that are steeper than the angle of repose of the compacted material in its natural state is prohibited.

10.4.1.9 Structural Foundations and Footings

Except in hard rock, excavations below the level of the base of any foundation, footing, or retaining wall will not be permitted unless the wall is underpinned and all necessary precautions are taken to ensure the stability of adjacent walls. If the excavation endangers the stability of adjacent buildings or structures, shoring, bracing, or underpinning designed by a qualified person will be installed. Such supporting systems must be inspected at least daily by qualified persons to ensure that protection is adequate and effectively maintained.

Small diameter footings that workers are required to enter, including bell-bottomed footings over 4 feet deep, must be provided with a steel casing or support system of sufficient strength to support the earth walls and prevent cave-ins. The casing or support system shall be provided for the full depth, except for the bell portion of bell footings.

Fixed or portable ladders must be provided for access. A lifeline, securely attached to a shoulder harness, should be worn by every employee entering the footing. The lifeline should be manned from above and should be separate from any line used to raise or lower materials.

10.4.1.10 Vertical Cuts and Slopes

Before a slope or vertical cut is undercut, the residual material must be adequately supported and the undercutting method and support system must be inspected.

When exposed to falling, rolling, or sliding rocks, earth, or other materials, employees working below or on slopes or cuts should be protected in the following manner:

- By effective scaling performed prior to exposure and at intervals necessary to eliminate the danger.

- By the installation of rock bolting, wire mesh, or equivalent support if the material continues to ravel and fall after scaling.

- By the installation of protective timber or wire mesh barricades at the slope of the cut and at necessary intervals down the slope. Wherever practical, benching sufficient to retain falling material may be used in lieu of barricades.

- By ensuring that personnel do not work above one another where there is danger of falling rock or earth. Personnel performing work on vertical cuts or slopes where balance depends on a supporting system must wear appropriate safety equipment.

10.4.1.11 Ground Water

Ground water should be controlled. Freezing, pumping, draining, and other major control measures should be planned and directed by a competent professional engineer. Full consideration should be given to the existing moisture balance in surrounding soil and the effects on foundations and structures if it is disturbed. When continuous operation of ground water control equipment is necessary, an emergency power source should be provided.

10.4.1.12 Surface Water

The accumulation of surface water in excavations must not be permitted and should be controlled by diversion ditches, dikes, dewatering sumps, or other effective means.

10.4.1.13 Excavated Materials

Excavated materials should be placed and retained at least 2 feet from the depth of the excavation, or at a greater distance when required to prevent hazardous loading on the face of the excavation.

10.4.1.14 Protective Devices

Guardrails, fences, barricades, and warning lights or other illumination systems will be maintained from sunset to sunrise on excavations adjacent to walkways, driveways, and other pedestrian or vehicle thoroughfares. Walkways or bridges that are protected by standard guardrails should be provided where employees are required or permitted to cross over excavations.

Wells, calyx holes, pits, shafts, and all similar hazardous excavations must be effectively barricaded or covered and posted. All temporary excavations of this type should be backfilled as soon as possible. When mobile equipment is permitted adjacent to excavations with steep slopes or cuts, substantial stoplogs or barricades should be installed.

10.4.1.15 Equipment Operation

Equipment that is operated on loading or waste areas must be equipped with an automatic backup alarm. Additionally, when employees are on foot or otherwise endangered by equipment in dumping or waste areas, a competent signalman should be used to direct traffic. The signalman must have no other assignment that interferes with signaling duties. If the equipment or truck cab is not shielded, the operator should stand clear of the vehicle during loading. Excavating or hoisting equipment should not be allowed to raise, lower, or swing loads over workers unless effective overhead protection is provided.

10.4.1.16 Drilling Operations

When drilling in rock or other dust-producing material, the dust should be controlled within the OSHA Permissible Exposure Limits (PELs). Except in shaft and tunnel excavation, dust control devices are not required on jackhammers as long as the operators wear approved dust respirators.

10.5 Confined Space Entry

In January 1993, OSHA promulgated a new, comprehensive Federal standard (29 CFR 1910.146) entitled "Permit Required Confined Spaces" specifically to protect workers who enter confined spaces. Although the standard allows for non-permit required confined space entry in some instances, Dames & Moore has taken the approach that all confined space entry shall be treated as permit required.

The purpose of this section is to establish safety practices for work conducted within confined spaces; however, compliance with these requirements does not preclude or preempt other standards.

10.5.1 Definition of a Confined Space

To be considered a confined space requiring a permit for entry, the space must meet the following four criteria:

- The space must be large enough and so configured that an employee can enter it and perform assigned work.

- The space must have limited or restricted means for entry and exit. In many cases, the entrances are smaller and contortion of the body is necessary for passage. In other instances, the entrance may be large, but removal of a disabled employee may be difficult. A common attribute of a confined space is that retrieval of a suddenly disabled employee presents a challenge.

- The space is not designed for continuous employee occupancy. Most confined spaces are designed to hold or enclose materials, processes, etc.

- The space may be hazardous or become hazardous due to one or more of the following conditions:

  - Contains or has the potential to contain a hazardous atmosphere;

- Contains a material which could engulf a person inside the space;

- Is configured internally such that an entrant could be trapped or asphyxiated inside the space; or

- Contains or may contain any other recognized serious safety or health hazard.

Confined spaces include, but are not limited to, the following:

- Storage tanks, tank cars, process vessels, bins, tank trailers, and other tank-like compartments, usually with one or more manholes for entry.

- Open-topped spaces of more than 4 feet in depth, such as bins, silos, pits, vats, tubs, vaults, vessels, or floating roof storage tanks.

- Ventilation or exhaust ducts, manholes, sewers, tunnels, pipelines, and similar structures.

- Ovens, furnaces, kilns, and similar enclosed structures.

10.5.2 Hazards of Confined Spaces

The following is a list of the most common hazards found in association with confined spaces:

- Oxygen deficiency—atmospheres that contain less than 19.5 percent oxygen. Normal fresh air contains 20.9 percent oxygen.

- Oxygen Enriched—an atmosphere with oxygen in excess of 23.5%. These types of atmospheres are considered a potential fire or explosion hazard.

- Combustible gases and vapors—atmospheres that may explode or ignite if a source of ignition is present in or introduced to the environment.

- Toxic gases and vapors—atmospheres that contain contaminants, including asphyxiants and irritants, that even in low concentration can cause serious injury or death.

- Mechanical Hazards—confined spaces can make it difficult to avoid contact with such machinery or electrical components that are located within the space.

- Engulfment Hazards—engulfment in confined spaces occurs when the victim is immersed in liquid or trapped and enveloped by finely divided, dry bulk materials. Bulk materials can either be aspirated into the respiratory system or their weight can crush the torso.

- Noise Hazards—scaling, chipping, grinding, hammering, riveting, power scrubbing, the use of power and pneumatic tools, and air line leaks can all create hazardous

noise levels. Noise inside a tank or vessel can be amplified within the confines of the space.

- Heat Stress Hazards—the sun on a metal tank or lack of air circulation can contribute to a hot environment, in addition to the use of protective clothing and equipment.

- Cold Stress Hazards—in cold weather, the metal of a tank can result in a cold environment inside the space.

One should anticipate that any combination of the above atmospheric conditions might exist in tunnels, utility manholes, vaults, sewers, subcellars, excavations, railroad tank cars, sump pits, silos, open tanks, rooftop mechanical penthouses, cold storage facilities, ship's holds, stacks and chimneys, ductwork, brewer's vats, mine tunnels, abandoned wells, sewage treatment plants, and sanitary landfills. Hazards also may appear unexpectedly in normal situations because of inappropriate industrial waste disposal or leakage of toxic substances into earth strata or conduits.

10.5.3 Training Requirements

All Dames & Moore employees who will be participating in confined space entry activities will receive Confined Space Entry training before their initial assignment to such work. At least one team member will be currently certified in first aid and CPR. The space entrant cannot be the sole entry team member certified in first aid/CPR.

Initial training will be supplemented with additional training as part of the annual 8-hour Hazardous Waste Operations Refresher instruction for Class 1 personnel. If necessary, separate refresher training for confined space entry work will be offered. The training will cover the following topics at a minimum:

- Confined Space Recognition
- Hazards of Confined Spaces
- Recognition of Symptoms of Exposure
- Training Requirements for Confined Space Entry Work
- Team Member Responsibilities
- System Preparation
- Equipment Requirements
- Practice with Instrumentation and Equipment
- Rescue Procedures
- Overview of Confined Space Entry Permit Parameters.

10.5.4 Confined Space Entry Permit

A confined space entry permit is a written or printed document that is provided by the employer to allow and control the entry into a permit-required space. Dames & Moore requires the use of a permit even in those cases where OSHA does not require a permit. In the case of a non-permit-required space per OSHA, the permit will serve as the Written Certification OSHA requires that the space is safe for entry. The following minimum information must be provided on the permit:

- Identification of the space to be entered.

- Purpose of the entry.
- Date and authorized duration of the entry permit.
- Authorized entrants within the permit space.
- Personnel serving as attendants.
- Individual serving as the supervisor.
- Hazards of the permit space.
- Measures used to isolate the permit space and to eliminate and control permit space hazards before entry.
- Acceptable entry conditions.
- Results of initial and periodic tests performed, accompanied by the name of the tester and indication of when the tests were performed.
- Rescue and emergency services that will be utilized and the means for initiating or summoning those services.
- Communication procedures used by authorized entrants and attendants to maintain contact during entry.
- Equipment used during the operation.
- Any other information whose inclusion is necessary.
- Any additional permits that have been issued to authorize work in the permit space; for example, a welding or hot work permit.

No one is to enter a permit-required confined space unless a permit, authorized for the specific site, has been completed by a health and safety professional.

10.5.5 Hazard Categories of Confined Spaces

CLASS A: A space containing an atmosphere that may be Immediately Dangerous to Life or Health (IDLH). Examples of IDLH conditions are:

- Oxygen deficiency (O_2 < 19.5%).
- Oxygen enriched atmosphere (O_2 > 23.5%).
- LEL or LFL > 10%.
- A toxic atmosphere is present.
- A combustible dust atmosphere is present that equals or exceeds its LFL or that obscures vision at a distance of 5 feet or less.

Entry can be made into a Class A confined space only with special precautions or equipment to reduce these hazards. These determinations will only be made by the SSO or his designee. At no time will an employee enter a space that is oxygen enriched or that has a LEL or LFL atmosphere over 10%.

CLASS B: A confined space that has an atmosphere where:

- Oxygen is between 19.5 and 23.5%.
- The LEL or LFL is less than 10%.
- A toxic atmosphere is not present.
- A combustible dust atmosphere does not exist.
- Any other recognized serious safety or health hazards are not present.

Entry into a Class B category may be made without any special modifications to the entry work procedure. In general, the basic provisions of confined space entry preparation, equipment, and crew requirements will be adequate for most Class B entries. All confined space entry work will be conducted in accordance with the confined space entry permit, following the entry parameters of the standards, unless specifically changed by the SSO, or designee. Any such modifications to the entry procedure shall not conflict with confined space entry regulations.

Because of the variety of hazardous conditions that may be encountered in confined space entry work, it is important that the potential hazards of the space be thoroughly evaluated so that adequate measures can be taken to allow safe completion of the project.

10.5.6 Confined Space Entry Preparation

Confined space entry work often presents a combination of hazards to the entrants and also to those who are supporting the job from outside the space. Effort spent at the beginning of a confined space entry for proper preparation will usually pay off during the actual entry in the following ways: 1) the entry may be able to be made with less stringent procedural and equipment requirements; 2) the entry may require less staffing; and 3) preparation pays off in terms of safety, time, money, and energy.

The following steps are in the usual order that these jobs should be accomplished:

1. Drain, flush, or purge all original contents from the space.

2. Blind flange, double block and bleed, de-energize, and lock-out all sources of material, energy, or motion into the space. In rare cases, a tag-out may be acceptable instead of a positive mechanical method.

3. Ventilate the space to rid it of flammable and/or toxic materials and provide air circulation. The space should have approximately 5 to 6 complete air changes per hour. Be sure that the positioning of the ventilation equipment does not block access to the entrance of the confined space or create a trip or electrocution hazard. Two ventilators (one to supply air and one to exhaust air) may be required depending on size, configuration, and atmospheric hazards of the space. Conversely, in some instances, mechanical ventilation may not be required for a particular confined space.

4. Control any sources of ignition such as sparks, open flame, welding/cutting equipment, and space heaters.

5. Survey the confined space entry site to ascertain that no hazards exist that could create problems—for example, machinery that could crimp or sever an airline hose.

6. Assemble and set up all other auxiliary equipment including wench/hoist mechanism or airline system.

7. Perform atmospheric checks of the space from the outside. Be sure to take readings from several areas inside the space; check corners, low-lying areas within the confined space, or portions of the space that may not be ventilated as uniformly as the rest of the space. Oxygen must be the first atmospheric parameter measured, followed by flammable vapor and any appropriate toxic contaminants.

8. Enter the results on the permit. Determine the hazard class of the confined space.

9. If conditions are suitable for entry, and all required equipment for entry is available and in working order, assemble all team members and proceed with site safety briefing.

10. If a prohibited condition develops during entry, or if entrants initiate self-rescue, work must stop and the permit is void.

10.5.7 Confined Space Entry Procedures

Workers should not enter a confined space unless the following precautions are followed:

- Under no circumstance should a worker enter a confined space without at least one individual standing by. This individual should be capable of monitoring what occurs in the confined area and be equipped to remove or initiate rescue of the worker in an emergency. The use of lifelines and safe communicating devices is recommended.

- All lines that contain harmful agents, such as supply, discharge, overflow, vent, drain, or similar connections entering the space, must be physically separated or blocked by means of blinds or other devices that are capable of ensuring complete closure, except fire suppressants and extinguishing systems.

- All fixed mechanical devices or equipment should be disconnected, because their operation might endanger the employee or cause additional hazards. Electrical service equipment, excluding lighting, should be padlocked or tagged (29 CFR 1910.145(f)).

- When adequate natural air movement or continuous forced ventilation is not provided, the atmosphere should be tested for oxygen deficiency (less than 19.5 percent oxygen). The internal atmosphere must be tested for combustible gas and for air contaminants in excess of published standards when there is reason to suspect their presence.

- Ventilation:

  - When air monitoring indicates an unsafe atmosphere, the space should be ventilated until the concentration of the hazardous substance(s) is reduced to a safe level or eliminated, at which time the employee is permitted to enter the confined space. Ventilation must be continued as long as recurrence of the hazard is probable.

  - As an alternative to ventilation, or if ventilation does not adequately reduce or remove the hazardous substance, a confined space should be entered only if an appropriate respirator is worn. If a self-contained respirator is used, sufficient primary air capacity should be available as well as reserve capacity to perform the task inside the confined space. The wearer of the respirator may not be permitted to remain in the confined space when the primary air system is depleted or is being replaced. The reserve air supplies of rescue personnel and ordinary workers should be used only in an emergency.

  - An adequate, continuous supply of air must be provided while work is performed under any of the following conditions:

    1. When combustible or explosive gas vapors have been initially detected and subsequently reduced to a safe level by ventilation.

    2. When organic solvents are used in the work procedure.

    3. When open-flamed torches are used in the work procedure.

    4. When in a manhole that is located in that portion of a public right-of-way open to vehicle traffic or exposed to a seepage of gases.

    5. When an oxygen deficiency or toxic gas is present.

  - The following provisions regarding communication must be met:

    1. Provision for constant communication with an employee in the immediate vicinity who is not in the confined space (use of the "buddy system").

    2. Provision for an adequate rescue procedure, including equipment specifically designed for rescue from the confined space.

    3. Provision for training in rescue and cardiopulmonary resuscitation procedures for employees working inside and outside the confined space.

- Lighting:

  - Temporary lights should be equipped with guards to prevent accidental contact with the bulb unless the bulb is deeply recessed within a reflector.

- Temporary lights should be equipped with heavy-duty electric cords, with connections and insulation maintained in safe condition. Temporary lights may not be suspended by their electric cords unless cords and lights are designed for this means of suspension. Splices should have insulation equal to that of a cable.

- Working spaces, walkways, and similar locations should be kept clear of cords.

- Portable electric lighting used in moist or other hazardous locations (e.g., drums, tanks, and vessels) should be operated at a maximum of 12 volts.

10.6 Soil Vapor Extraction Equipment

Dames & Moore owns and operates Soil Vapor Extraction (SVE) equipment at various remediation sites. This brief list of safety requirements covers hazards specific to this type of operation. The list assumes that safety requirements for standard operations inherent in SVE operations are already being followed, such as 29 CFR 1910.120 "Hazwoper" planning, training, and other requirements; or drilling, trenching, and shoring safety practices.

The components of a typical set of SVE equipment can include an electric or gasoline powered motor, a carbon adsorption bed, and various filters, piping, and controls.

10.6.1 Basic Requirements

10.6.1.1 General

Employees will not proceed with work on, or in the proximity of, SVE equipment until they have been properly trained and have attended a safety briefing covering the hazards involved. This may be in the form of a "tailgate" safety briefing or a more extensive session, depending upon the extent of the hazards, the employees' safety knowledge, and site-specific exposures.

The use of unsafe or defective equipment is not permitted. Equipment must be inspected regularly and, if found to be defective, immediately removed from use and repaired or replaced.

Employees should be familiar with the location of first-aid kits and fire extinguishers. Telephone numbers or radio frequencies for emergency assistance must also be prominently posted and kept current.

10.6.1.2 Housekeeping

Good housekeeping practices should be observed in and around the work area. Suitable storage should be provided for all materials and supplies.

Any work surfaces, platforms, stairways, walkways, scaffolding, or accessways should be kept free of obstructions. Any debris should be collected and stored in piles or containers for removal and proper disposal.

10.6.1.3 Flammable Liquids

All highly flammable liquids should be stored and handled only in approved containers. Portable containers must be of the approved, red safety container type, equipped with flame arresters and self-closing lids.

Approved hand pumps should be used to dispense gasoline from drums. Gasoline must not be used for degreasing or starting fires. Also, gasoline containers should be clearly labeled, and any storage areas should be posted with "No Smoking" signs. Fire extinguishers should be installed in all area that contain flammable liquids.

10.6.1.4 Public Safety

Work areas should be regulated so that the public will be protected from injury or accident. Adequate danger signs, barriers, etc., should be placed to effectively warn the public of hazards as well as to restrict access to dangerous areas.

10.6.1.5 Drilling Safety

Construction of soil vapor extraction systems requires installation of soil vapor extraction wells and separate air inlet wells. Safety requirements for drilling operations should be followed.

10.6.2 Specific Requirements

10.6.2.1 Chemical Hazards

Some of the primary chemical hazards at SVE operations are site contaminants because SVE equipment is used to treat sites contaminated with volatile organic compounds. Contaminant vapors drawn from extraction wells are commonly treated with carbon adsorption units or are incinerated. Additional chemical hazards associated with these treatment technologies include fuel for the incinerator and activated carbon saturated with site contaminants. Manufacturers' Material Safety Data Sheets should be available on site for all neat chemical compound used.

Personnel can be exposed to site contaminants during sampling and equipment maintenance. Because soil vapor extraction systems are typically closed systems terminating in contaminant oxidization or adsorption apparatus, chances of exposure incidents during normal operations are minimal. If chemical exposure occurs, however, it is most likely during sampling or equipment maintenance. Sampling typically includes sampling of site soils or ground water to measure the long-term effectiveness of remediation activities, or sampling process water or vapors to determine the efficiency of treatment technologies in capturing or destroying the contaminants.

A potential for exposure exists during maintenance procedures because of cleaning sediment from knockout pots and from general piping system repairs.

In order to minimize the potential hazards associated with chemical exposure, all site workers should have a knowledge of particular site hazards and contaminants. Based upon site conditions, proper personal protective equipment should be worn such as hard hats, chemical protective clothing, and safety shoes.

10.6.2.2 Physical Hazards

Physical hazards can be managed by general housekeeping in work areas and routine equipment maintenance. Scaffolding may be erected around water stripping towers and incinerators and should be inspected periodically, as part of a routine maintenance procedure.

10.6.2.3 Pressure

SVE systems create a vacuum to draw soil vapors from the ground. The vacuum created is a potential hazard, and remedial equipment should be shut off when maintenance activities or repairs occur.

10.6.2.4 Electric Hazards

Because several types of equipment in SVE systems are commonly powered by electricity, electrical hazards exist at these remedial sites. Liquid ring vacuum pumps, knockout pumps, air stripper holding tanks and pumps, and other elements of the treatment units are frequently powered by electricity. General housekeeping and equipment maintenance are necessary to prevent electrical safety hazards. Worn switches and wiring should be quickly repaired, use of water should be controlled, and unnecessary spills prevented. Ground fault interrupters (GFI) should be used on all circuits carrying power from a nearby indoor source to outdoor equipment or from an outdoor portable generator to SVE equipment. Equipment should also be properly grounded as a protection against shocks, static electricity, and lightning if an electrical storm occurs.

10.6.2.5 Lighting

In addition to providing required or recommended illumination intensities of at least 5 foot-candles for nighttime operation, consideration should be given to the selection and placement of lighting equipment. Proper lighting should provide minimum glare, eliminate harsh shadows, and provide adequate illumination to perform work efficiently and safely. Light bulbs should be of the heavy duty, outdoor, nonshattering type.

All lighting circuits, including extension cords, should be grounded and have GFI protection. Circuits and extension cords should be inspected periodically.

10.6.2.6 Incinerator/Treatment System

Thermal hazards exist with incinerators, and boundaries should be set up to prevent contact with heated surfaces. Additionally, proper thermal protection should be available for personnel working at the incinerator. Vapor extractor pumps should be set to shut off automatically if the incinerator shuts off, to prevent accumulation of high concentrations of volatile compounds that could result in an explosion hazard.

10.6.2.7 Carbon Bed Temperature

A hazard related to carbon adsorption units is the heat of reaction, which is high for some materials, such as ketones, treated in high concentrations. SVE equipment should be designated to take this into account when carbon adsorption is employed and the bed temperature must be monitored.

10.7 Boating Safety

This section establishes safety practices for boating operations.

10.7.1 General Operating Requirements

The following general operating requirements pertain to all Dames & Moore boating operations, regardless of size or extent.

- The boat operator is responsible for the safety of all persons and equipment on board and the operator must provide a safety briefing for all occupants of the boat prior to leaving the dock, pad, etc. Boat operators must complete emergency first-aid training.

- Boats are not to be boarded by unauthorized or non-essential persons (e.g., family, dependents, or friends).

- For extensive boating operations, the employee in charge should have taken the U.S. Coast Guard Boating Skills and Seamanship course or its equivalent.

- Personal gear should include shoes or boots with anti-skid soles and footwear suitable for sampling or other work done outside the boat. Water repellent clothing and sufficient warm clothing should be taken along on the boat, and a change of dry clothing is often needed.

- Boat operators shall initiate operations on the ocean, estuaries, large lakes, and large rivers only after acquiring a current and reliable weather forecast. Common sense must prevail. When in doubt, the safer course of action is required.

- Auxiliary fuel should be stored in safety cans and secured to prevent spillage, away from sources of heat and sparks.

- Boats must be equipped with non-slip floorboards.

- Excess equipment is to be minimized and that which remains on board should be stowed in such a way that walkways are kept clear and fire hazards are avoided.

10.7.2 Required Equipment

- Every motorboat shall have a fire extinguisher approved for fighting electrical fires or burning liquids, e.g., gasoline. (A 2.5-pound dry chemical extinguisher will satisfy the requirement, but a 6-pound dry chemical extinguisher will offer a greater chance of putting out a liquid fuel fire.) The fire extinguisher should be located convenient to the fueling area to put out spill fires.

- All boats operated in estuaries or open seas should be equipped with two-way radios adequate to communicate with at least one shore station. Boats with marine radios will monitor a distress frequency when not transmitting.

- Boats from 16 to 26 feet long must carry an audible signal, such as a whistle or horn, that can be heard for at least a half mile. A police whistle will meet this requirement.

- Boats with enclosed spaces where spilled fuel or fuel vapors can accumulate must have powered ventilation to clear away the fuel vapors. This requirement does not normally apply to open boats.

- All passengers must wear life jackets, although divers are permitted to wear wet suits in lieu of life jackets. Boats must also carry at least one towable flotation device.

- Floatation devices Types I, II, III, IV, and V can be used. Types I and V are designed to save an unconscious person from drowning because they will turn an unconscious person from a face-down position in the water. The Type I device provides maximum flotation and thus maximum protection in rough water. The Type V device is designed for work activities. Float coats or exposure suits approved by the Coast Guard are recommended for cold water operation. Wet suits can also be used, preferably with an additional flotation device.

11.0 HAZARD COMMUNICATION

11.1 General

The Dames & Moore Hazard Communication Program complies with the OSHA Hazard Communication Standard (HCS) found in 29 CFR 1910.1200 and 29 CFR 1926.59, which applies to any chemical present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency. Although waste materials are excluded from the OSHA requirement, decontamination chemicals for sampling apparatus or protective clothing (such as acetone or trisodium phosphate) and calibration standards (such as isobutylene gas) require Material Safety Data Sheets (MSDS).

The principle of communicating the hazards of materials used in the workplace to employees applies broadly to firmwide activities, from informational programs on the conduct of hazardous waste activities to the firm's insistence upon adequate safety and health training. It is also important for personnel to have an awareness of client concern for Hazard Communication due to Federal, state, and local regulations directly affecting certain client activities.

11.2 Compliance Requirements

In order to comply with Hazard Communication Standard (29 CFR 1910.1200), Dames & Moore has determined that:

- All containers of hazardous chemicals must be appropriately labeled or tagged to identify the hazard and provide information on effects and appropriate protective measures.
- Labels, tags, or signs must be properly affixed and visible at all times while a hazard is present and removed promptly when the hazard no longer exists.
- Written information (MSDS) on hazardous chemicals in the workplace must be available to employees working with the substance.
- Appropriate MSDS will be available to any contractor or subcontractor employees working in Dames & Moore offices) or laboratories or at construction, excavation, or other sites under Dames & Moore's control.
- Hazard Communication Training should be provided to Dames & Moore employees.

The Dames & Moore Hazard Communication program is further described in the firm Health and Safety Manual, procedure HS 140.

Any MSDS required for this project should be attached to this HSP.

12.0 POSTING OF NOTICE

Under provisions of Title 29, CFR Part 1903.2(a)(1), employers must post a notice, furnished by OSHA, informing employees of the protection and obligations provided for in OSHA Act of 1970. If the state in which the site is located has a federally approved form, a state-provided form may be used instead of the federal. The state form should be present whether or not the federal notice is used. Full-sized state and/or federal forms will be used, and not a small copy of the federal form that is referenced in Section 15.0 and attached for information purposes (Form 8, Occupational Safety and Health Administration Poster for Private Industry Form).

Where a site office is established, this notice will be posted in a conspicuous place or places where notices to employees are customarily posted. When working out of the cab of a vehicle, such notice is not required. If required, attach state/federal notices to this plan. The state form must be obtained from the state occupational safety office. The federal form may be obtained from the U.S. Department of Labor, OSHA Publication Office, Room N3101, 200 Constitution Avenue, NW, Washington, DC, 20210, (202) 523-9667. The states that have forms are Alaska, Arizona, California, Connecticut, Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virgin Islands, Virginia, Washington, and Wyoming.

13.0 TOXIC SNAKE AND INSECT BITES AND PLANTS

13.1 Poisonous Snakebites

13.1.1 General

Reactions from snakebite are aggravated by acute fear and anxiety. Other factors that affect the severity of local and general reaction from poisonous snakebite include: the amount of venom injected and the speed of absorption of venom into the victim's circulation; the size of the victim; protection from clothing, including shoes and gloves; quick antivenin therapy; and location of the bite.

13.1.2 First Aid Procedure

The objective of first aid is to reduce the circulation of blood through the bite area, to delay absorption of venom, to prevent aggravation of the local wound, and to sustain respiration.

The most important step is to get the snakebite victim to the hospital quickly. Meanwhile, take the following first aid measures:

1. Keep the victim from moving around.

2. Keep the victim as calm as possible and preferably in a lying position.

3. Immobilize the bitten extremity and keep it at or below heart level. If the victim can reach a hospital within 4 to 5 hours and if no symptoms develop, no further first aid measures need be applied.

4. If mild-to-moderate symptoms develop, apply a constricting band 2 to 4 inches above the bite, but not around a joint (the elbow, knee, wrist, or ankle) and not around the head, neck, or trunk. The band should be 3/4 to 1 1/2 inches wide, not thin like a rubber band. The band should be snug but loose enough for a finger to be slipped underneath. Watch out for swelling. Loosen the band if it becomes too tight, but do not remove it. Periodically check the pulse in the extremity beyond the bite to insure that the blood flow has not stopped.

5. If severe symptoms develop, make an incision and apply suction immediately. Apply a constricting band, if this has not already been done, and make a cut in the skin through the fang mark(s). Use a sharp, sterilized knife. Cuts should be 1/2 inch long, extending over the suspected venom deposit point. (Because a snake strikes downward, the deposit point is usually lower than the fang mark.) Cuts should be made along the long axis of the limb. Do not make cross-cut incisions. Do not make cuts on the head, or trunk. Apply suction with a suction cup for 30 minutes. If a suction cup is not available, use the mouth. There is little risk to the rescuer who uses his mouth, but it is recommended that the venom not be swallowed and that the mouth be rinsed out.

If the hospital is not close, that is, if it cannot be reached in 4 or 5 hours, take the following measures:

- Keep trying to obtain professional care, either by transporting the victim to a place where medical care is available or by using an emergency communications system to obtain medical advice.

- If no symptoms develop, keep trying to reach the hospital and give the general first aid described above.

- If any symptoms at all develop, apply a constricting band, make incisions, and apply suction immediately, as described above in steps 4 and 5.

Several other factors must be considered in cases of snakebite:

- Shock. Keep the victim lying down and comfortable, and maintain his or her body temperature.

- Breathing and heartbeat. If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform cardiopulmonary resuscitation (CPR) if you have been trained to do so.

- Identifying the snake. If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.

- Cleaning the bitten area. You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages, but only for a short period of time.

- Medicine to relieve pain. Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Some painkillers, however, may be given. Consult a doctor or other medical personnel for specific medications that may be used.

- Snakebite kits. Keep a kit accessible for all outings in primitive areas or areas known or suspected to snake infested.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of snakebite.

13.2 Other Poisonous Bites

13.2.1 Spiders

Spiders in the United States are generally harmless, with two notable exceptions: the Black Widow spider (Latrodectus Mactans) and the Brown Recluse or violin spider (Lox Osceles Reclusa).

The symptoms of a Black Widow spider bite are: slight local reaction, severe pain produced by nerve toxin, profuse sweating, nausea, painful cramps in abdominal muscles, and difficulty in

breathing and speaking. Victims recover in almost all cases, but an occasional death is reported. The bite of a Black Widow spider is the more painful and often the more deadly of the two.

Field personnel should exercise caution when lifting covers off manholes or sumps, or rummaging through wood, rock, or brush piles, etc. since both the Black Widow and Brown Recluse spiders can typically be found in these areas.

13.2.2 Scorpions

Scorpions inject venom through a stinger in the tail. In bites from the more dangerous species, there are marked systemic effects within 1 to 2 hours. Fatalities have been recorded.

The symptoms of a scorpion bite are: excruciating pain at the site of the sting, nausea and vomiting, abdominal pain, shock, and possible development of convulsions and coma.

13.2.3 General First Aid for Poisonous Insect Bites:

- Minor Bites and Stings
  - Cold applications.
  - Soothing lotions, such as calamine.
- Severe Reactions
  - Give artificial respiration if indicated.
  - Apply a constricting band above the injection site on the victim's arm or leg (between the site and the heart). Do not apply tightly. You should be able to slip your index finger under the band when it is in place.
  - Keep the affected part down, below the level of the victim's heart.
  - If medical care is readily available, leave the band in place; otherwise, remove it after 30 minutes.
  - Apply ice contained in a towel or plastic bag, or cold cloths, to the site of the sting or bite.
  - Give home medicine, such as aspirin, for pain.
  - If the victim has a history of allergic reactions to insect bites or is subject to attacks of hay fever or asthma, or if he or she is not promptly relieved of symptoms, call a physician or take the victim immediately to the nearest location where medical treatment is available. In a highly sensitive person, do not wait for symptoms to appear, since delay can be fatal.
  - In case of a bee sting, remove and discard the stinging apparatus and venom sac.

13.3 Tickborne Diseases

13.3.1 Lyme Disease

Lyme disease is an illness caused by a bacterium which may be transmitted by the bite of a tick (Ixodes Dammini), commonly referred to as the "Deer Tick". The tick is about the size of a sesame seed, as distinguished from the Dog Tick, which is significantly larger. The Deer Tick is principally found along the Atlantic coast, living in grassy and wooded areas, and feeds on mammals such as mice, shrews, birds, raccoons, opossums, deer, and humans. Not all ticks are infected with the bacterium, however. When an infected tick bites, the bacterium is passed into the bloodstream of the host, where it multiplies. The various stages and symptoms of the disease are well recognized and, if detected early, can be treated with antibiotics.

Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouth parts enter the skin and tug gently, but not firmly, until it releases its hold on the skin. Save the tick in a jar labelled with the date, body location of the bite, and the place where it may have been acquired. Wipe the bite thoroughly with an antiseptic and seek medical attention as soon as possible.

The illness typically occurs in the summer and is characterized by a slowly expanding red rash, which develops a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage treatment by a physician is usually effective; but, if left alone, these early symptoms may disappear and more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems which may occur include meningitis and neurological and cardiac abnormalities. It is important to note that some people do not get the characteristic rash but progress directly to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

When in an area suspected of harboring ticks (grassy, bushy, or woodland area) the following precautions can minimize the changes of being bitten by a tick:

1. Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists.

2. Wear light colored clothing so ticks can be easily spotted.

3. Wearing tick repellents may be useful.

4. Inspect clothing frequently while in tick habitat.

5. Inspect your head and body thoroughly when you return from the field.

6. Remove any attached ticks by tugging with tweezers where the tick's mouth parts enter the skin. Do not squeeze or crush it.

13.3.2 Rocky Mountain Spotted Fever

In the eastern and southern United States this tickborne disease is transmitted by the infected Dog Tick (Dermacentor Variabilis). It is important to note that the Dog Tick is significantly larger than the Deer Tick. Nearly all cases of infection occur in the spring and summer, generally several days after exposure to infected ticks. The onset of illness is abrupt and often accompanied by high fever, headache, shills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash that usually starts on the hands and feet and gradually extends to most of the body. As with Lyme disease, early detection and treatment significantly reduces the severity of illness. The disease responds to antibiotic therapy with tetracycline or chloramphenicol.

13.3.3 Other Tickborne Diseases

Ticks transmit several other diseases, most of which are rare and occur only in specific areas. Babesiosis occurs mainly in the Cape Cod area and eastern Long Island. Colorado tick fever is similarly regional and occurs only among those who live or work at altitudes above 4,000 feet.

13.4 Poisonous Plants

13.4.1 Characteristic Reactions

The majority of skin reactions following contact with offending plants are allergic in nature and are characterized by general symptoms of headache and fever, itching, redness, and a rash.

Some of the most common and most severe allergic reactions result from contact with plants of the Poison Ivy group including Poison Oak and Poison Sumac. the most distinctive features of poison ivy and Poison Oak are their leaves, which are composed of three leaflets each. Both plants also have greenish-white flowers and berries that grow in clusters. Such plants produce a severe rash characterized by redness, blisters, swelling, and intense burning and itching. The victim can also develop a high fever and become very ill. Ordinarily, the rash begins within a few hours after exposure, but it may be delayed for 24 to 48 hours.

13.4.2 First Aid Procedure

1. Remove contaminated clothing.

2. Wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.

3. Apply calamine or other soothing skin lotion if the rash is mild.

4. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

14.0 HAZARDOUS MATERIALS SHIPPING

14.1 Basic Requirements

The U.S. Department of Transportation (DOT) regulates the packaging, marking, labeling, and transport of hazardous materials in commerce. Dames & Moore personnel may become involved in transporting hazardous materials through laboratory, sampling, decontamination, or other activities. For example, concentrated acid may be taken to a field site to fix a sample; samples gathered for laboratory analysis could contain concentrations adequate to fulfill one or more hazard class definitions and therefore be considered hazardous; or calibration gas may have to be shipped to a field location. DOT allows the use of International Civil Aviation Organization (ICAO) technical instructions, or International Air Transportation Association (IATA) air shipping regulations; some air carriers (e.g., Federal Express) follow IATA regulations instead of DOT domestic regulations.

Note that EPA hazardous waste regulations do not apply to samples taken from hazardous waste sites due to the exclusion in the Resource Conservation and Recovery Act (40 CFR 261.4) that exempts samples taken for laboratory analysis from EPA manifesting, transportation, and storage requirements. However, classification and packaging of the samples as hazardous material, if such is the case, is still required.

Whether the hazardous materials are samples, reagents, or other materials, DOT hazardous materials regulations apply, and civil and criminal penalties are possible for noncompliance. In particular, the person who offers hazardous materials for shipment or transports non-exempt quantities of hazardous materials must sign a manifest declaring that the materials are properly packaged, marked, and labeled.

Personnel involved in the transportation of any hazardous materials, whether preservatives, decontamination or calibration chemicals, or DOT hazardous samples, must be trained. Section 8.5 above, Additional Training Requirements, summarizes this DOT requirement.

14.2 Shipping Identified Hazardous Materials

The Hazardous Materials Transportation Table (49 CFR 172.101) or the IATA List of Dangerous Goods is the starting point for handling hazardous materials properly. By following the instructions in the appropriate table and accompanying regulations, the proper container, packaging, marking, labeling, and manifesting requirements will be met. Those who will be packaging or transporting hazardous materials should obtain a copy of the pertinent regulations. What follows is information specifically on samples, since sample shipping decisions can be difficult unless sample constituents are identified through DOT-related testing in a laboratory.

Samples that fulfill hazard class definitions have the same transportation requirements as other hazardous materials; however, a problem arises when samples are presumed hazardous but the constituents are unknown. For such cases the following guidance has been developed. Any

manifest, whether for identified hazardous materials or for samples considered hazardous, should have:

- The emergency response phone number.
- The emergency response guide number next to each Proper Shipping Name.
- The letters "RQ" at the beginning of the Proper Shipping Name, when applicable.

14.3 Shipping Samples

The following general guidelines have been developed to aid in determining whether a sample should be considered hazardous for compliance with the Department of Transportation (DOT) and International Air Transport Association (IATA) shipping regulations. Samples may not frequently meet the DOT or IATA definition of a hazardous material; however, the following guidelines should be considered when shipping samples to prevent inadvertent shipment of hazardous samples as non-hazardous.

Samples should be considered hazardous when any of the following conditions have been met:

- Samples of neat chemicals collected from drums or containers, of free product, or of hazardous waste streams that are listed in the hazardous materials tables and meet the DOT or IATA definition of a hazardous material.
- Liquid samples that have a pH of less than 2 or greater than 12.5. Samples preserved in accordance with SW-846 or 40 CFR 136 that are preserved with acids or bases are not considered to be DOT hazardous by reason of low or high pH; but this does not preclude the sample from being hazardous due to its other characteristics.
- Samples that are believed to contain hydrocarbons (including chlorinated hydrocarbons) and exhibit a head space reading of 10 ppm or greater.
- Samples that contain radioactive materials with an activity of greater than 0.002 microCuries/gram.
- Samples containing pesticides in concentrations that may potentially approach the percentage concentrations listed in Table 3.6.D of the IATA regulations. Note that most pesticides listed in this table must be at a concentration of 10,000 ppm or greater to be considered hazardous.

Samples that do not meet the criteria of a hazard class or division are not considered hazardous and do not have to be shipped as a hazardous material.

It is believed most contaminated soil and water samples that exhibit headspace readings in excess of the above criteria will have Proper Shipping Names of "Environmentally hazardous substance, liquid, n.o.s. UN 3082" or "Environmentally hazardous substance, solid, n.o.s. UN 3077." The packing group associated with this Proper Shipping Name is always Packing Group III.

This will not be the case when samples collected exhibit significant amounts of free product, the sample is saturated with product, or immiscible liquids are present that meet the definition of a hazardous material. Such samples should be called "Flammable liquid, n.o.s. UN 1993" or whatever Proper Shipping Name best applies to the specific conditions. The packing group for these materials will generally fall into the Packing Group II category, or whichever Packing Group is associated with that Proper Shipping Name, unless that material does not meet the criteria of the assigned Packing Group.

The particular requirements for each type of sample shipped from this site are:

- proper shipping name and UN/ID number
- the specification number for inner and outer packaging
- other special instructions; e.g., "Cargo Aircraft Only," etc.

These specific requirements for each sample type are listed in Part II of the HSP.

15.0 FORMS

The following forms will be provided to the SSO during final preparations for departure to the job site:

- Form 1 Subcontractor Statement of Compliance Form
- Form 2 Bloodborne Pathogens Incident Evaluation Form
- Form 3 Accident/Exposure Report Form
- Form 4 Equipment Log Form
- Form 5 Air Monitoring Data Form
- Form 6 Site Safety Briefing Form
- Form 7 Confined Space Entry Permit Form
- Form 8 OSHA Poster for Private Industry Form
- Form 9 Plan Acceptance Form
- Form 10 Plan Feedback Form

The Subcontractor Statement of Compliance Form (Form 1) will be filled out and signed by each Dames & Moore Subcontractor that will be engaging in field activities at the site. The Bloodborne Pathogens Incident Evaluation Form (Form 2) will be completed by the Project Manager whenever an exposure to bloodborne pathogens incident occurs. The Accident/Exposure Report Form (Form 3) will be filled out by the Project Manager if an accident occurs. The Equipment Log Form (Form 4) and the Air Monitoring Data Form (Form 5) will be filled out by Site Safety Officer. The Site Safety Briefing Form (Form 6) will be filled out by the SSO and signed by all persons who received the site safety briefing. The Confined Space Entry Permit Form (Form 7) will be filled out by the SSO and the permit issued by Dames & Moore. The OSHA Poster for Private Industry Form (Form 8) will be posted as described in Section 13.0. The Plan Acceptance Form (Form 9) will be filled out by all employees working on the site. The Plan Feedback Form (Form 10) will be filled out by the SSO and any other on-site employee who wishes to fill one out.

ALL COMPLETED FORMS SHOULD BE RETURNED TO THE OFFICE SAFETY COORDINATOR FOR RETENTION IN PROJECT FILES.

16.0 MATERIAL SAFETY DATA SHEETS

If applicable, the MSDS for any chemical used for this project should be attached to this HSP. MSDSs for the following common decontamination and calibration substances and product are provided with this HSP in Appendix G-D:

Isobutyiene
Alconox
Trisodium Phosphate Dodecahydrate
Acetone
Hexanes
Ethanol
Nitric Acid
Portland Cements

Where possible, use MSDS provided by the manufacturer or supplier of the chemical, as an MSDS provided with this plan may have been prepared by a different manufacturer than the chemical that will actually be used at the site.

TABLES

TABLE G6-1

PROTECTIVE EQUIPMENT FOR ONSITE ACTIVITIES

ACTIVITY	LEVEL	PROTECTIVE EQUIPMENT
Site remediation, oversight of UST excavation, removal and disposal; site restoration, subsurface soil and ground water sampling.	C	- Full facepiece air purifying respirator - Chemical-resistant clothing - Inner and outer chemical resistant gloves - Safety boots - Hard hat - Hearing protection *
Same as above	D	- Work clothes or coveralls - Safety boots - Safety glasses or goggles - Hard hat - Hearing protection *

* Mandatory only when working in proximity of high noise generating equipment (e.g., generator, drill rig, etc.)

TABLE G10-1

SIGNS AND SYMPTOMS OF COLD STRESS

Incipient frostbite is a mild form of cold stress characterized by sudden blanching or whitening of the skin.

Chilblain is an inflammation of the hands and feet caused by exposure to cold moisture. It is characterized by a recurrent localized itching, swelling, and painful inflammation of the fingers, toes, or ears. Such a sequence produces severe spasms, accompanied by pain.

Second-degree frostbite is manifested by skin with a white, waxy appearance and the skin is firm to the touch. Individuals with this condition are generally not aware of its seriousness, because the underlying nerves are frozen and unable to transmit signals to warn the body. Immediate first aid and medical treatment are required.

Third-degree frostbite will appear as blue, blotchy skin. The tissue is cold, pale, and solid. Immediate medical attention is required.

Hypothermia develops when body temperature falls below a critical level. In extreme cases, cardiac failure and death may occur. Immediate medical attention is warranted when the following symptoms are observed:

- Involuntary shivering
- Irrational behavior
- Slurred speech
- Sluggishness.

TABLE G10-2

SIGNS AND SYMPTOMS OF HEAT STRESS

Heat rash may result from continuous exposure to heat or humid air.

Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

- Muscle spasms
- Pain in the hands, feet, and abdomen.

Heat exhaustion occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale, cool, and moist skin
- Heavy sweating
- Dizziness, fainting, and nausea.

Heat stroke is the most serious form of heat stress. Temperature regulation fails, and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. Competent medical help must be obtained. Signs and symptoms are:

- Red, hot, and unusually dry skin
- Lack of or reduced perspiration
- Dizziness and confusion
- Strong, rapid pulse, and coma.

Have workers drink 16 ounces (0.5 liter) of fluid (preferably water or diluted drinks) before beginning work. Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight. Weigh workers before and after work to determine if fluid replacement is adequate.

Encourage workers to maintain an optimal level of physical fitness. Where indicated, acclimatize workers to site work conditions.

Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure.

Train workers to recognize, identify, and treat heat stress.

TABLE G10-3

SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING
FOR FIT AND ACCLIMATIZED WORKERS[b]

Adjusted Temperature[a]	Normal Work Ensemble[c]	Impermeable Ensemble
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F (28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

[a] Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = °F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent of the time the sun is not covered by clouds that are thick enough to produce a shadow (100% sunshine = no cloud cover and a sharp, distinct shadow; 0% sunshine = no shadows).

[b] For work levels of 250 kilocalories/hour.

[c] A normal work ensemble consists of cotton overalls or other cotton clothing with long sleeves and pants.